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*Atmospheric Infrared Sounder*



# Temperature bias trends in the AIRS Level 2 Data

**Thomas Hearty**

Jet Propulsion Laboratory, California Institute of Technology

AIRS Science Team Meeting,  
Greenbelt, MD  
September 26-29, 2006



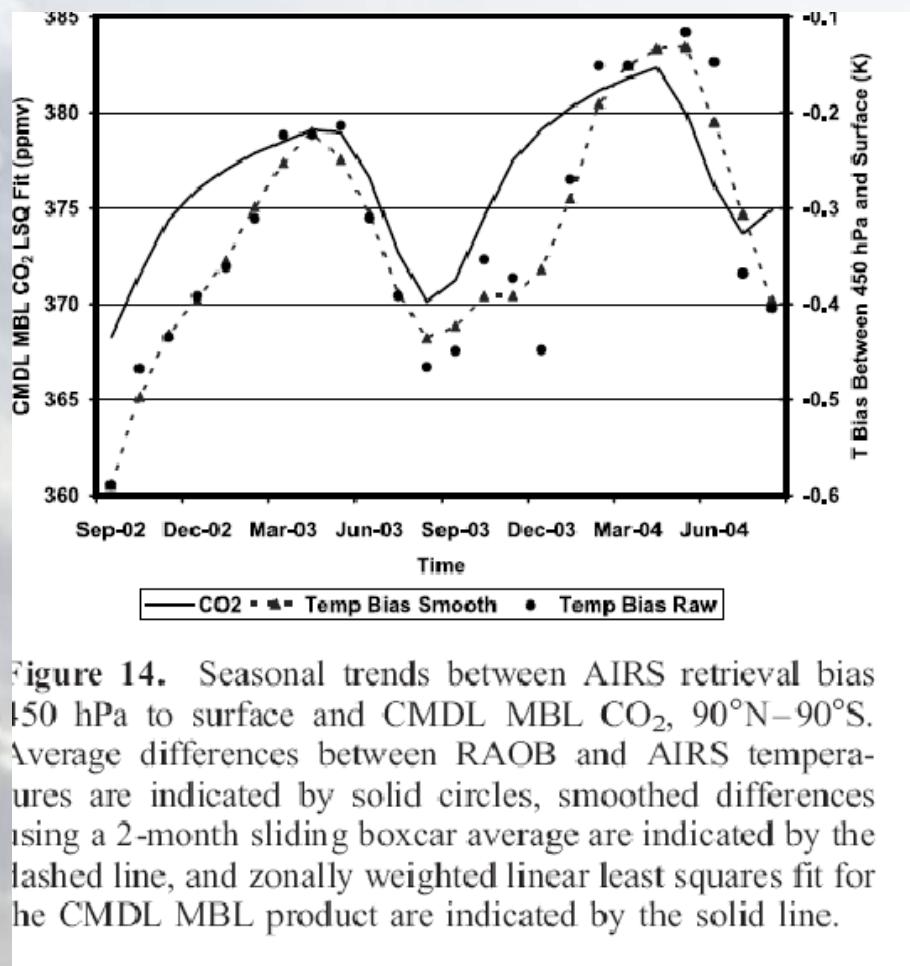
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## Atmospheric Infrared Sounder

- Divakarla et al. 2006 showed a seasonal variation in the v4.0.x AIRS tropospheric temperature bias from 400 mbar to the surface..
- Appears to be correlated with CO<sub>2</sub>

# Temperature Bias Trend





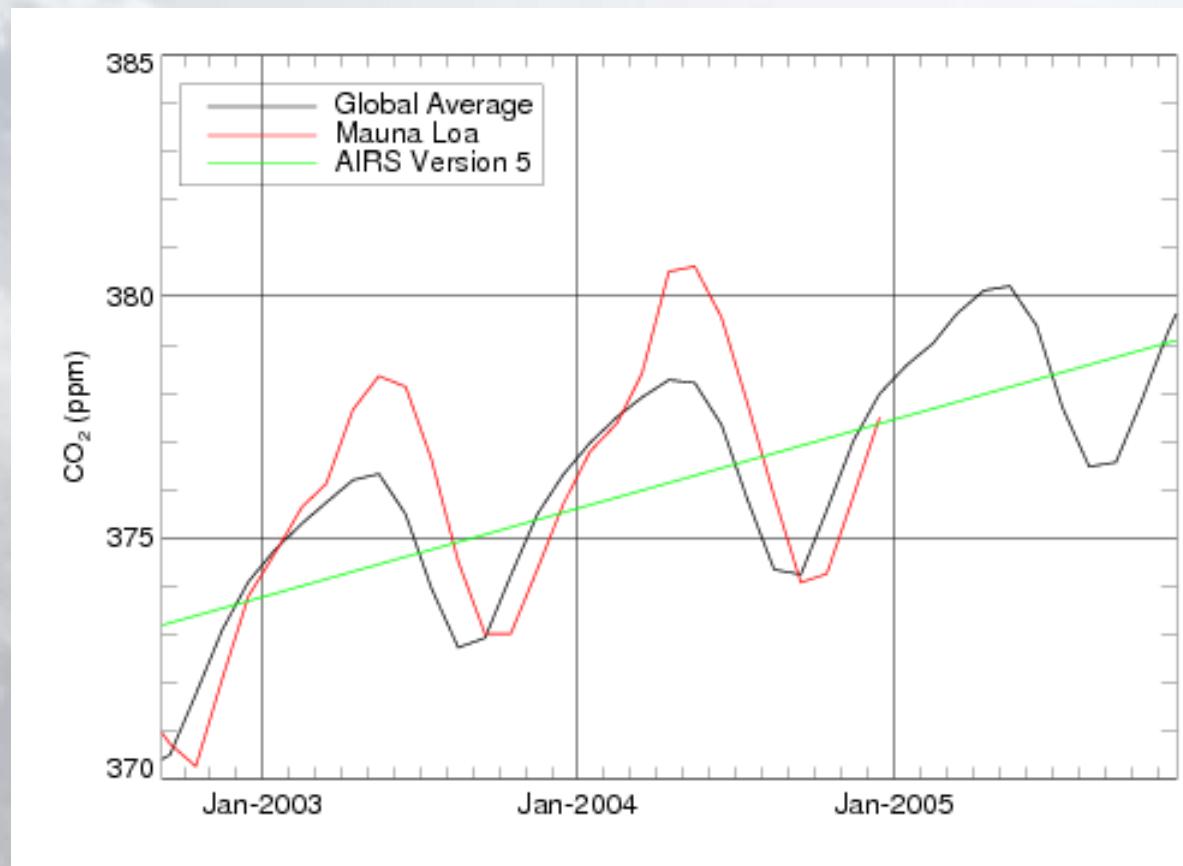
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### Atmospheric Infrared Sounder

- Version 4 of the PGE used a static value for CO<sub>2</sub> of 370 ppm.
- Version 5 will use a linearly varying CO<sub>2</sub> amount.

## Version 5 CO<sub>2</sub>





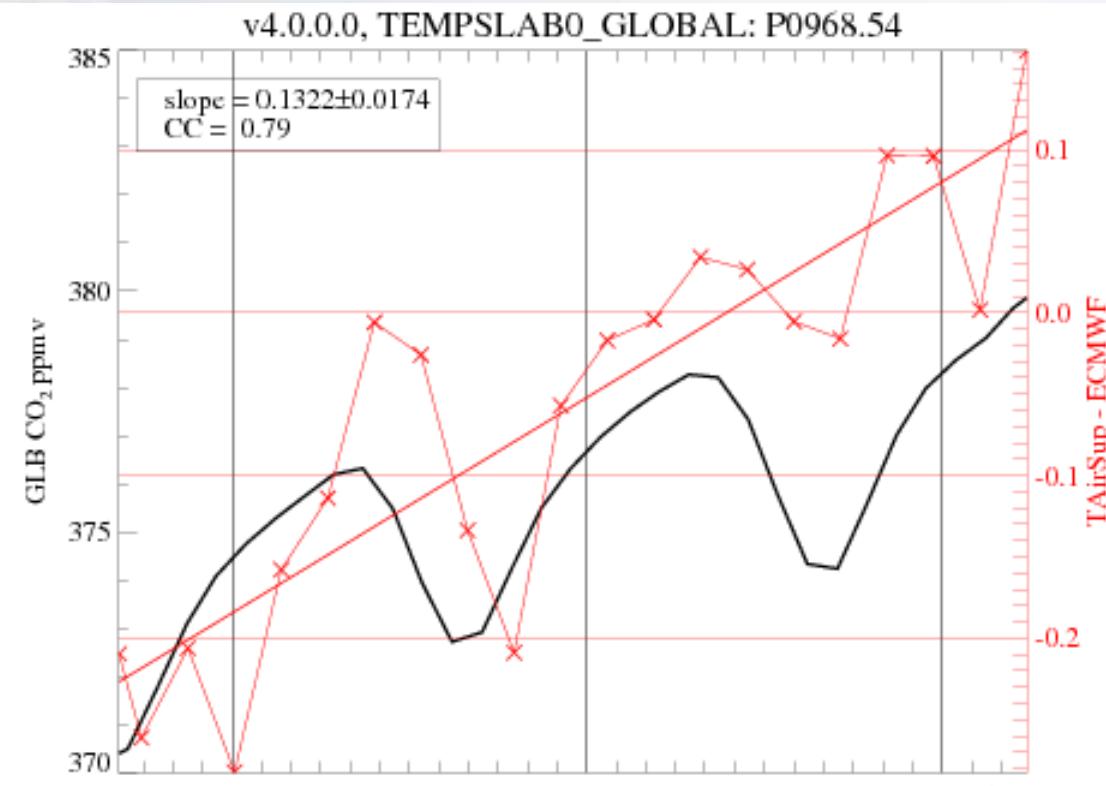
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### Atmospheric Infrared Sounder

The Version 4 Focus Days shows a similar temperature bias trend in the temperature from 850 mbar to the surface.

# Version 4 Focus Days





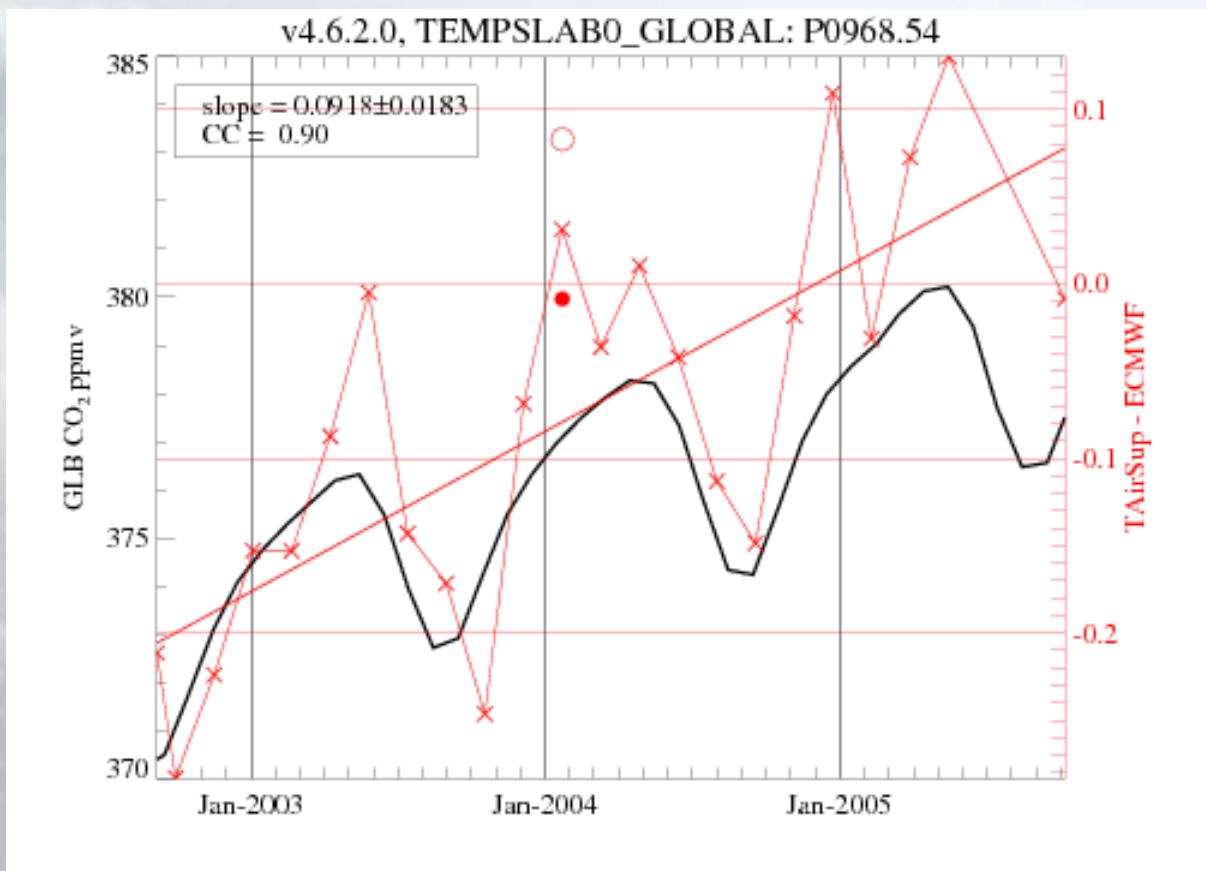
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### Atmospheric Infrared Sounder

- Version 4.6.2 (with variable CO<sub>2</sub>) shows a similar trend.
- Changing the CO<sub>2</sub> amount does change the temperature bias but does not remove the trend.
- The filled circle is with a 5% increase in CO<sub>2</sub> the open circle is a 5 % decrease in CO<sub>2</sub>

# Version 4.6.2 Temperature Bias





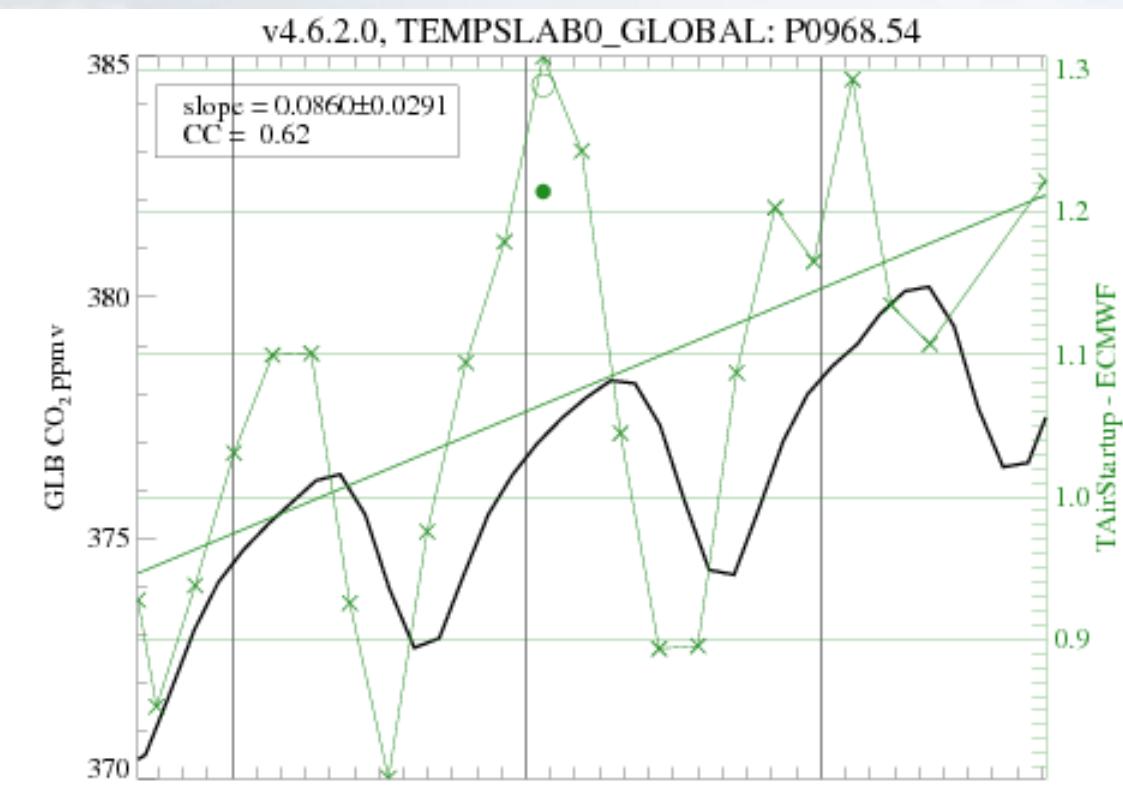
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### Atmospheric Infrared Sounder

- The Microwave temperature also shows a trend even though it is not sensitive to CO<sub>2</sub>!
- It might have a slightly different phase.

# Microwave Temperature Bias





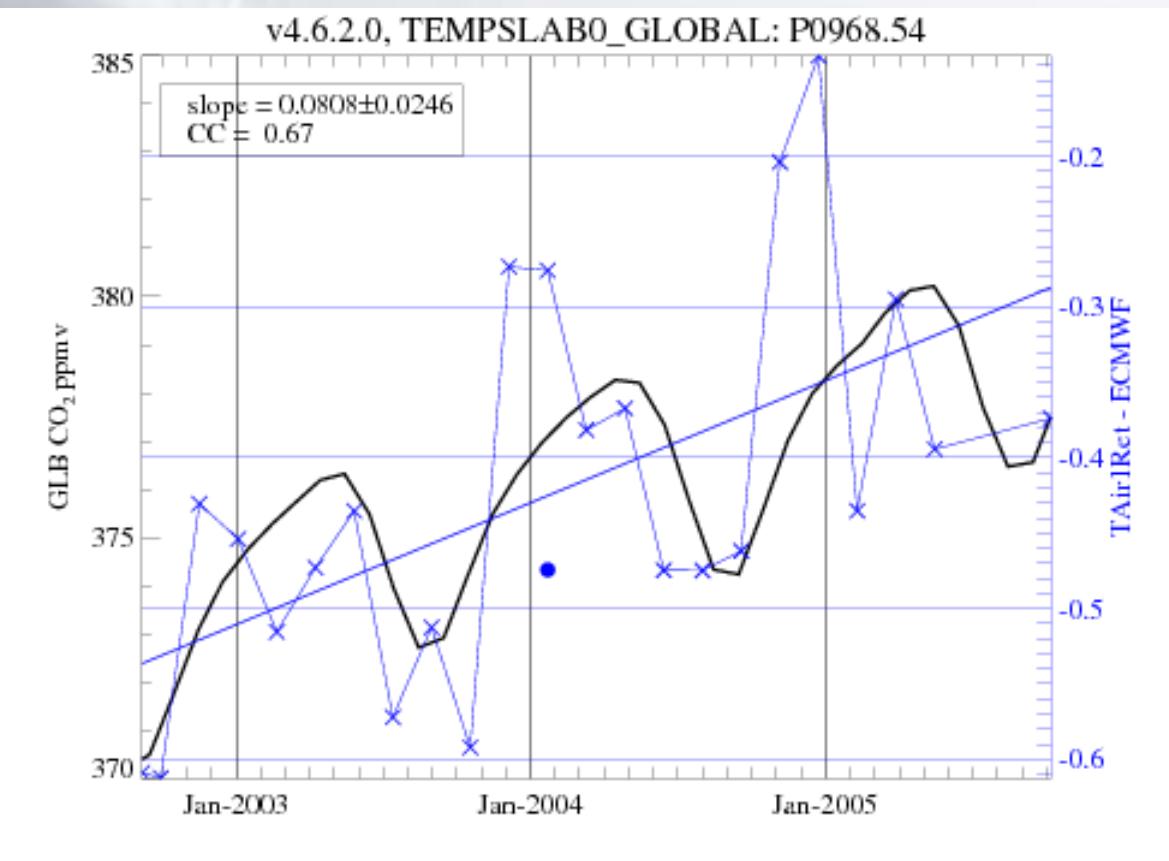
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- The regression retrieval also shows a trend.
- Changing the CO<sub>2</sub> amount may have a bigger effect on the regression.

# Regression Temperature Bias





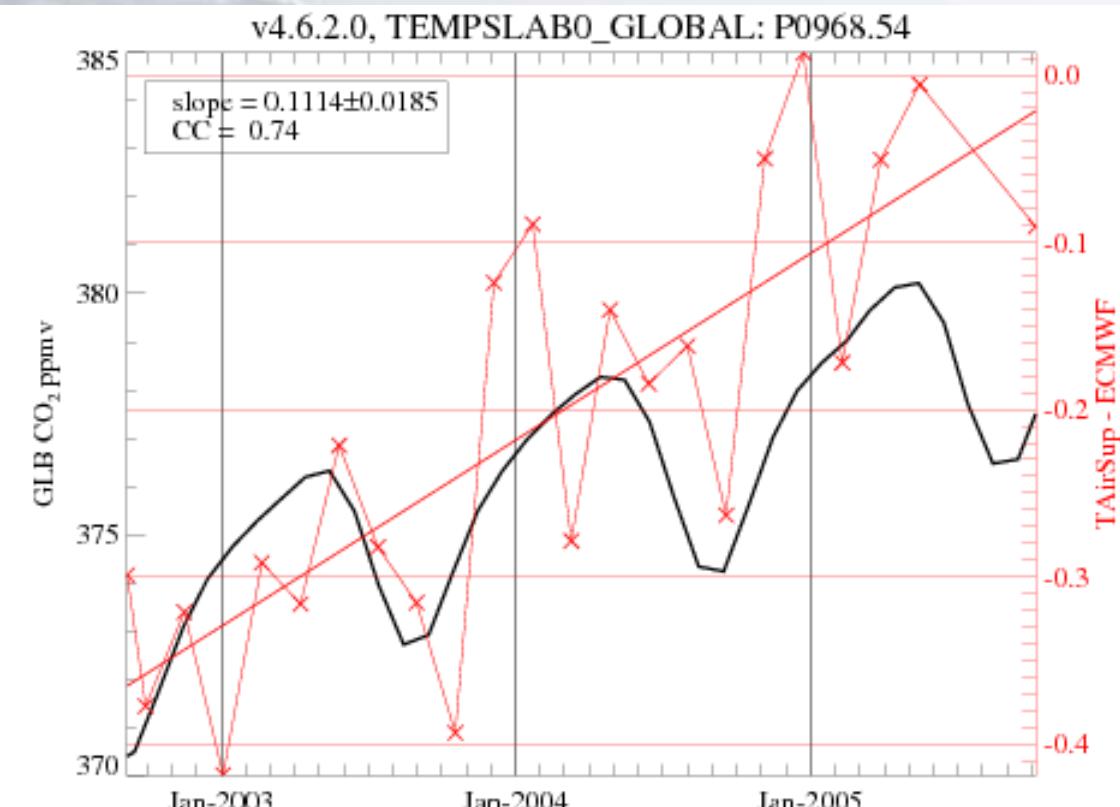
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The trend in the  
AIRS-Only  
temperature bias is  
there even with no  
microwave.

# AIRS-Only Temperature Bias



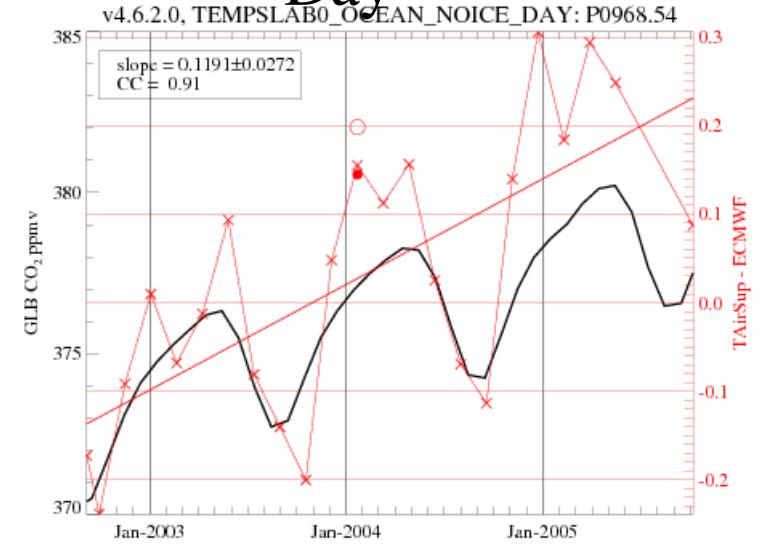


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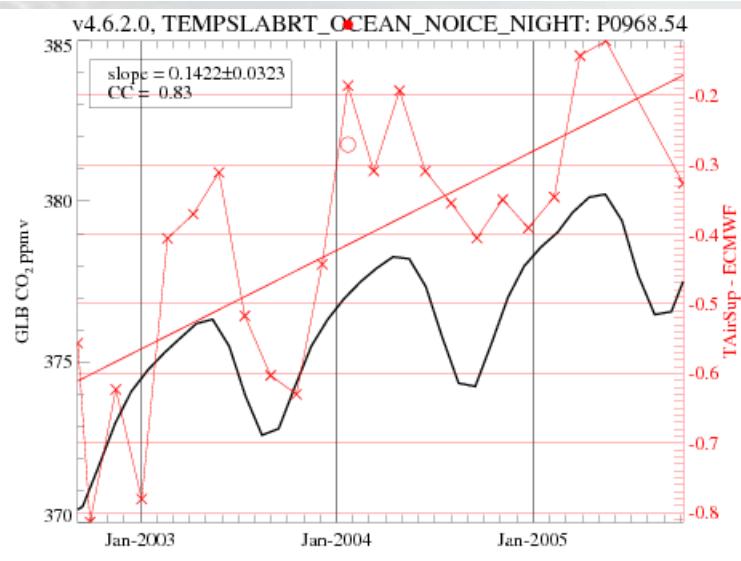
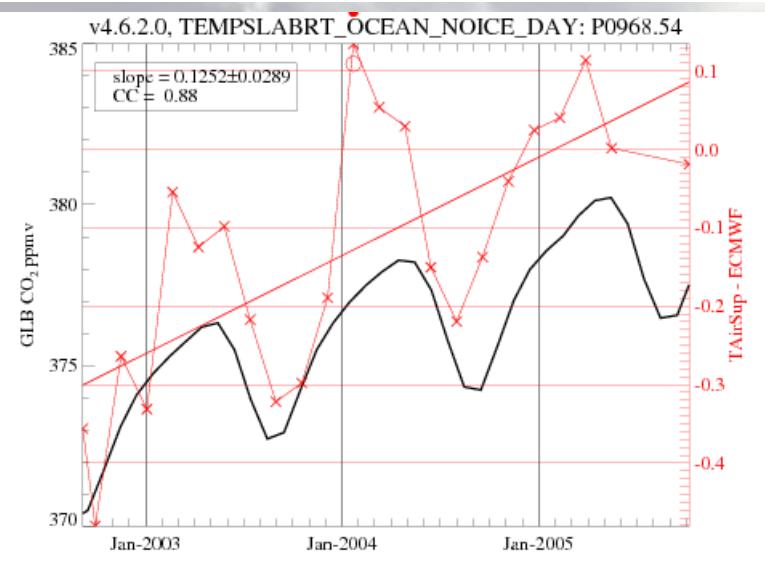
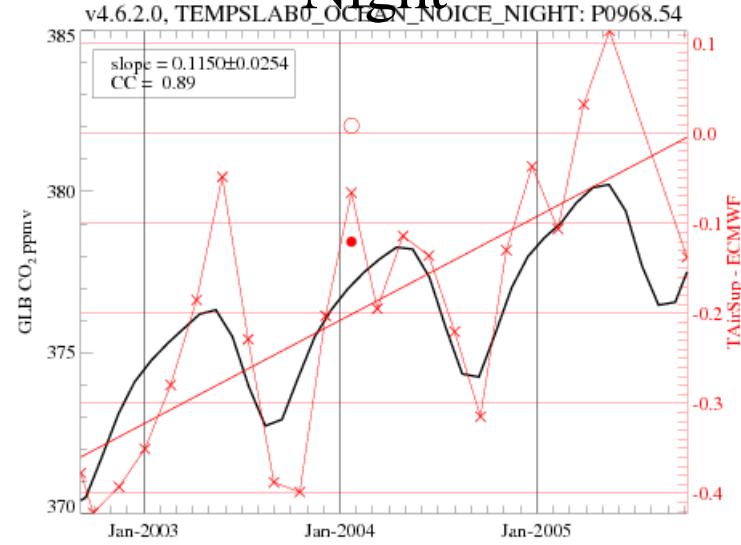
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### Atmospheric Infrared Sounder

# Day



# Night



Qual\_\* = 0

retrieval  
type ≠ 100



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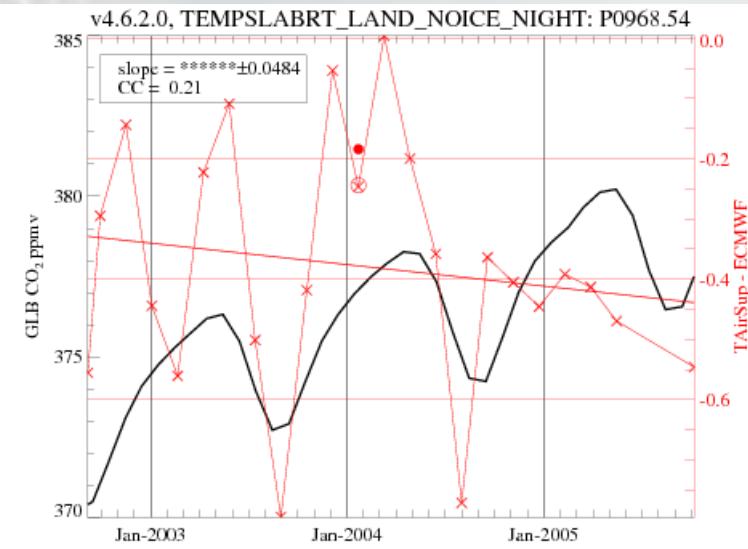
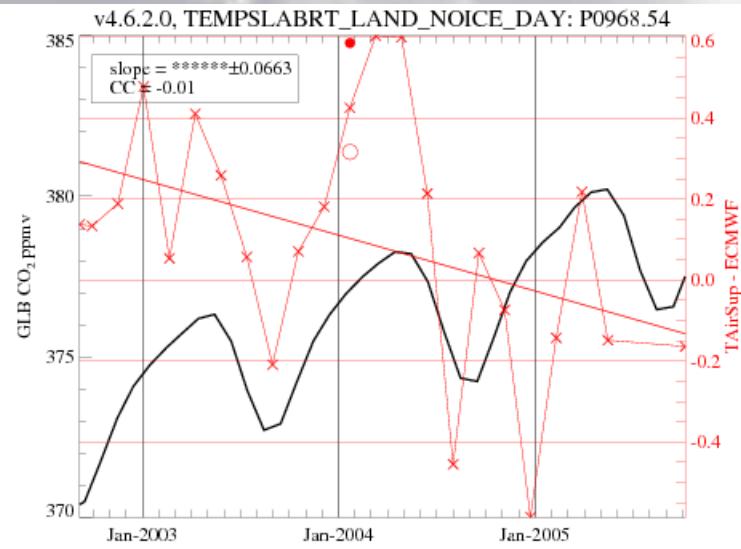
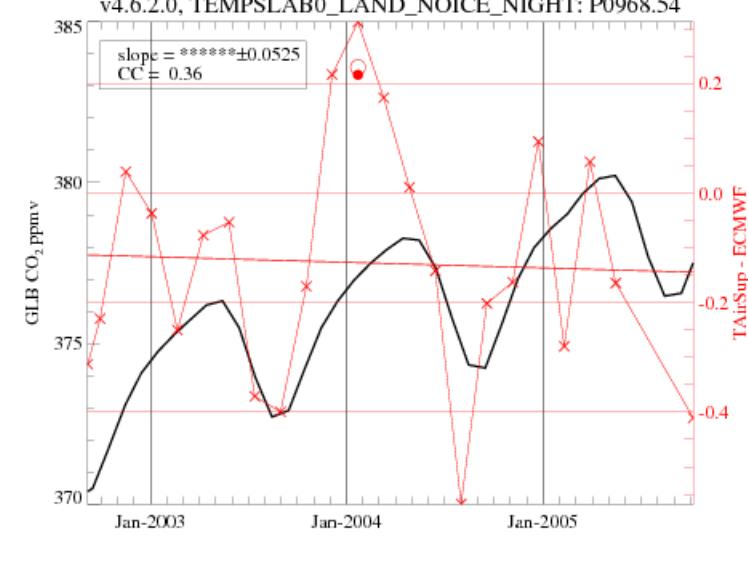
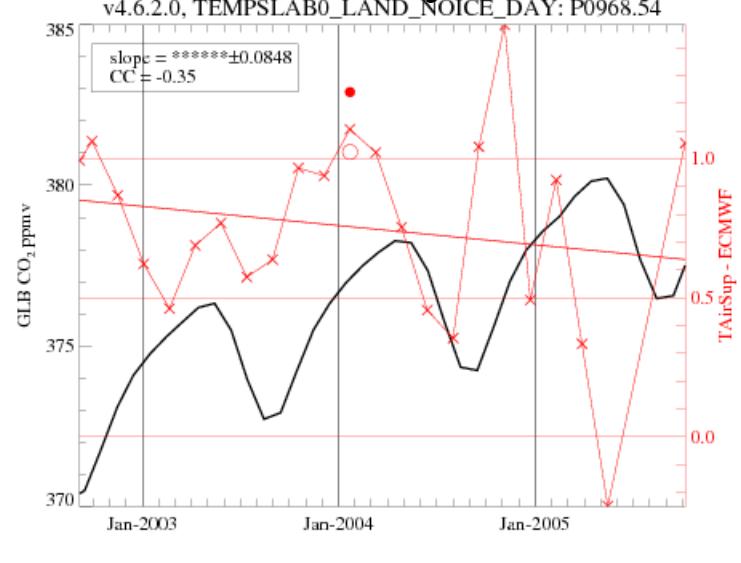
## Atmospheric Infrared Sounder

# Land and Ice are different

Day

Night

Qual\_\* = 0



retrieval  
type ≠ 100



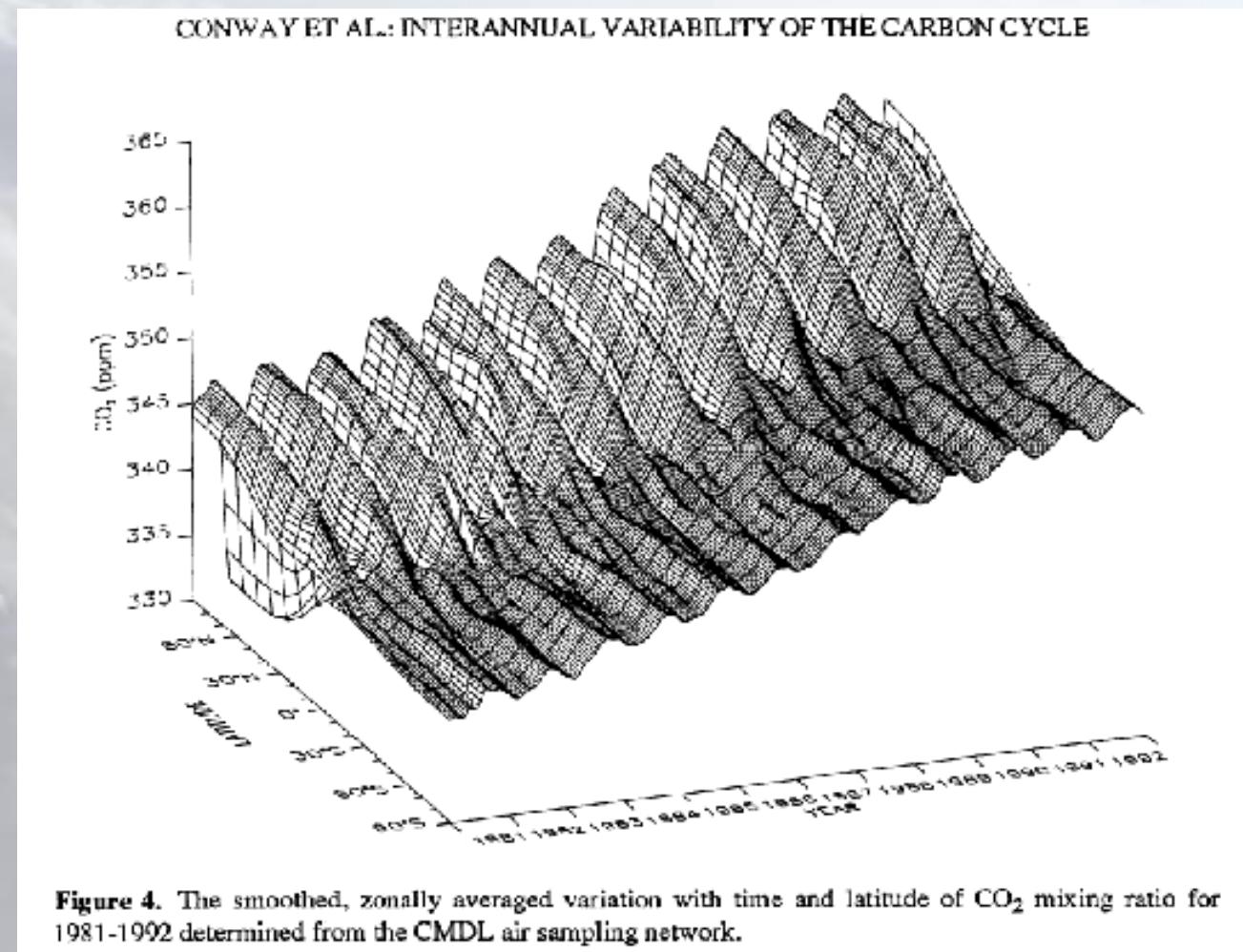
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### Atmospheric Infrared Sounder

Conway et al. 1994  
Showed the  
latitudinal variation  
of CO<sub>2</sub>.

# CO<sub>2</sub> Latitudinal variation





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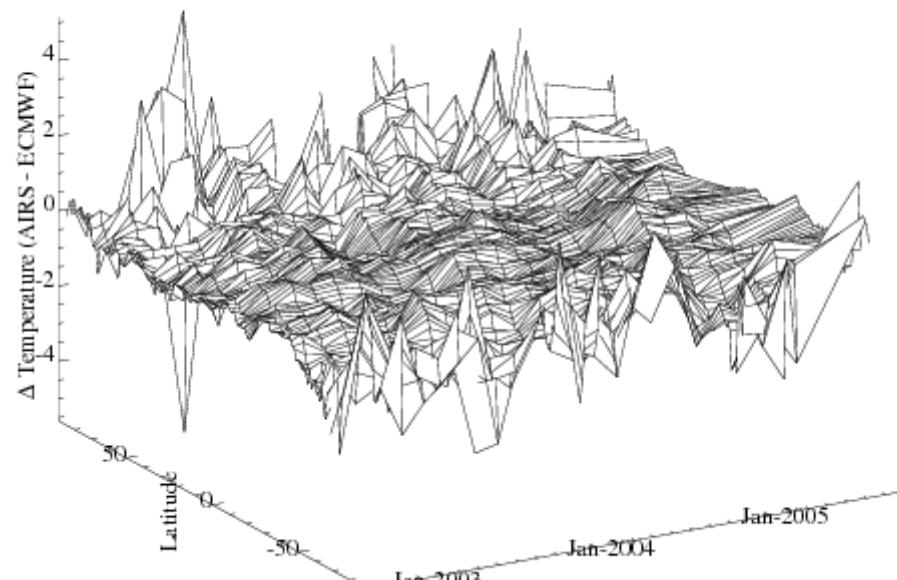
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The temperature bias  
has almost no  
latitudinal variation.

# Latitudinal variation of temperature bias

TAirSup NFO:968.54 mbar, Qual\_Temp\_Profile\_\* = 0



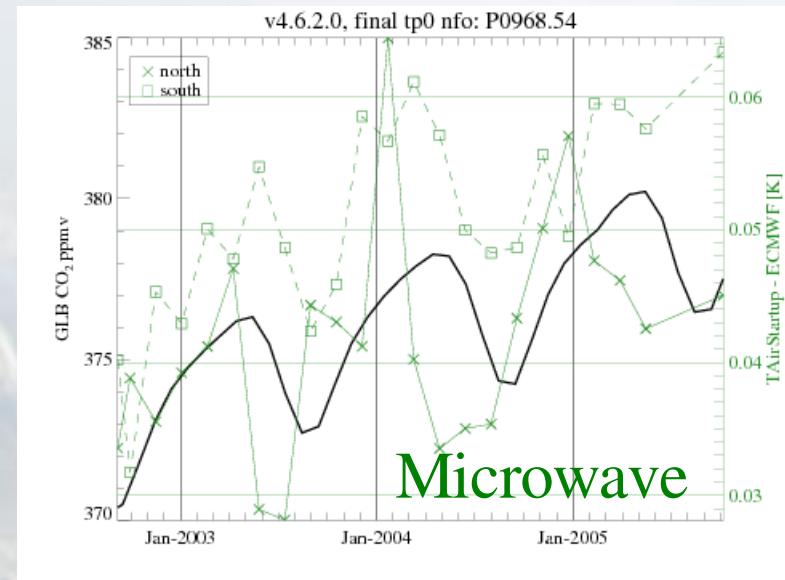


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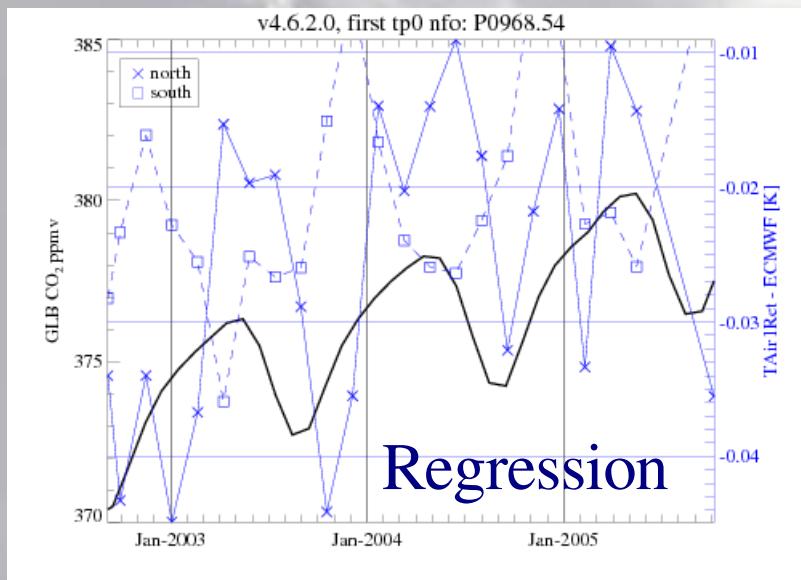
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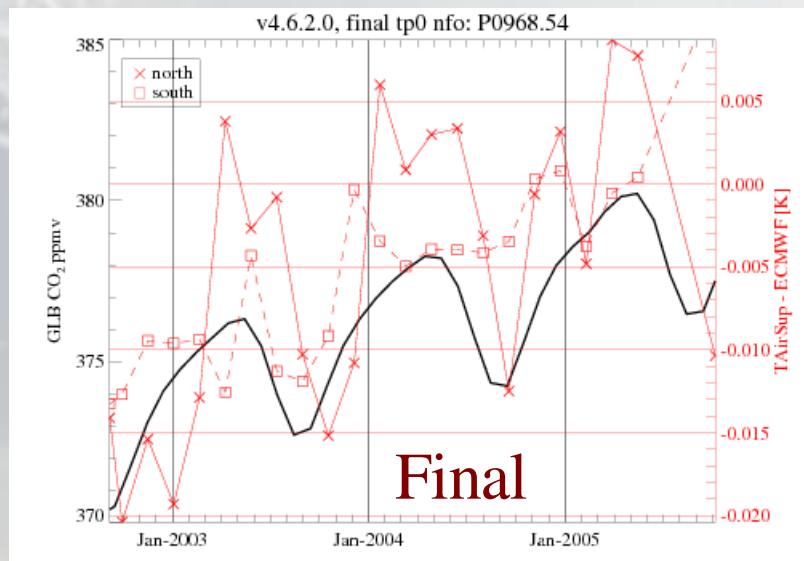
# The north may have a greater seasonal variation than the south



Microwave



Regression



Final



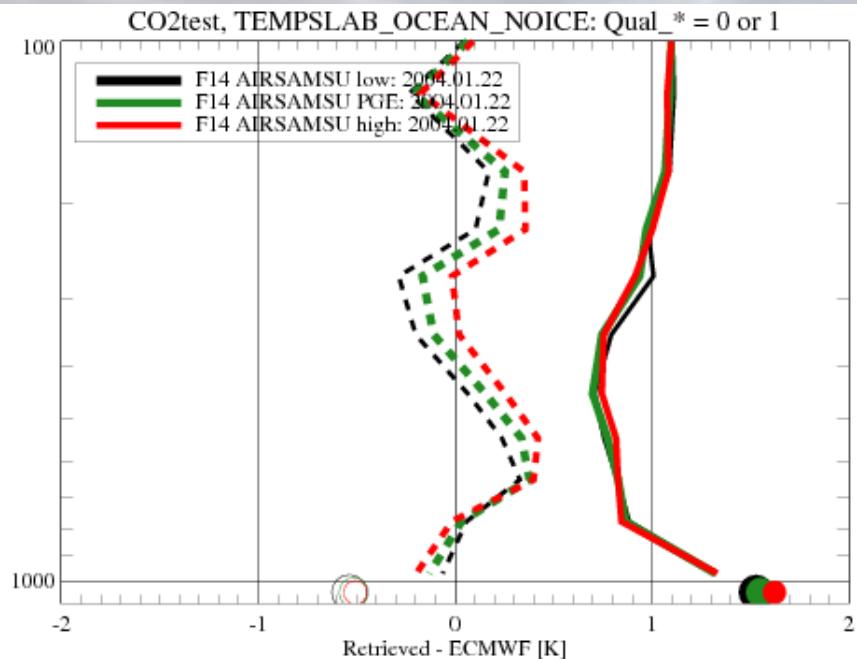
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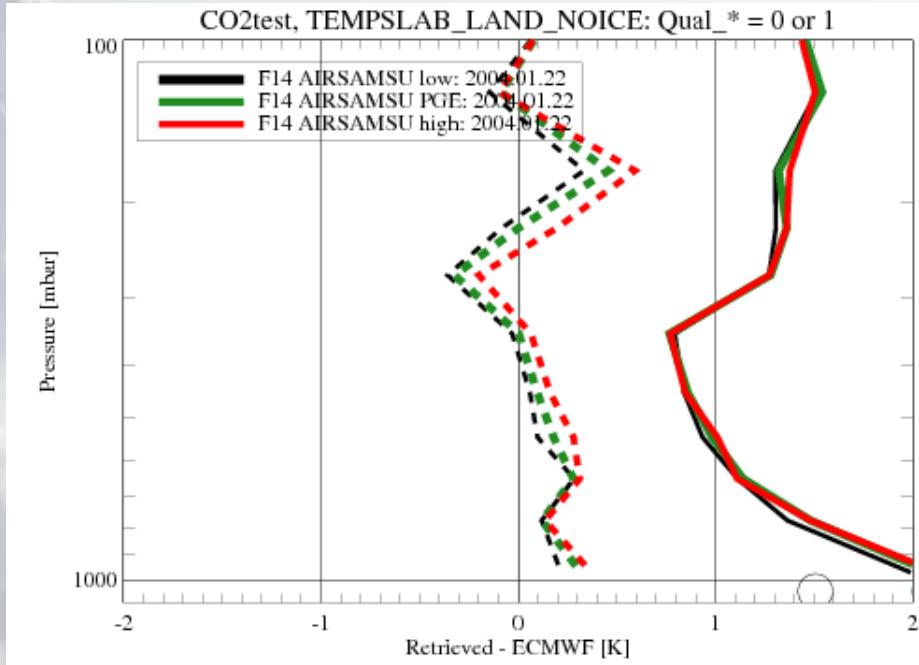
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# $\text{CO}_2$ vertical effect on temperature

Ocean



Land



Low  $\text{CO}_2$  increases the temperature near the surface over ocean and decreases the temperature over land. Higher in the troposphere low  $\text{CO}_2$  reduces the temperature.



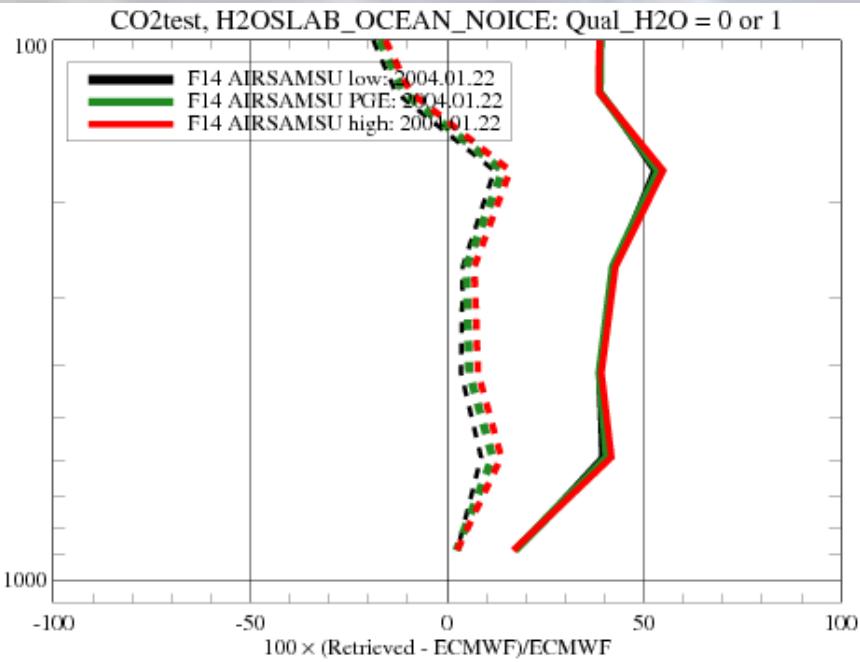
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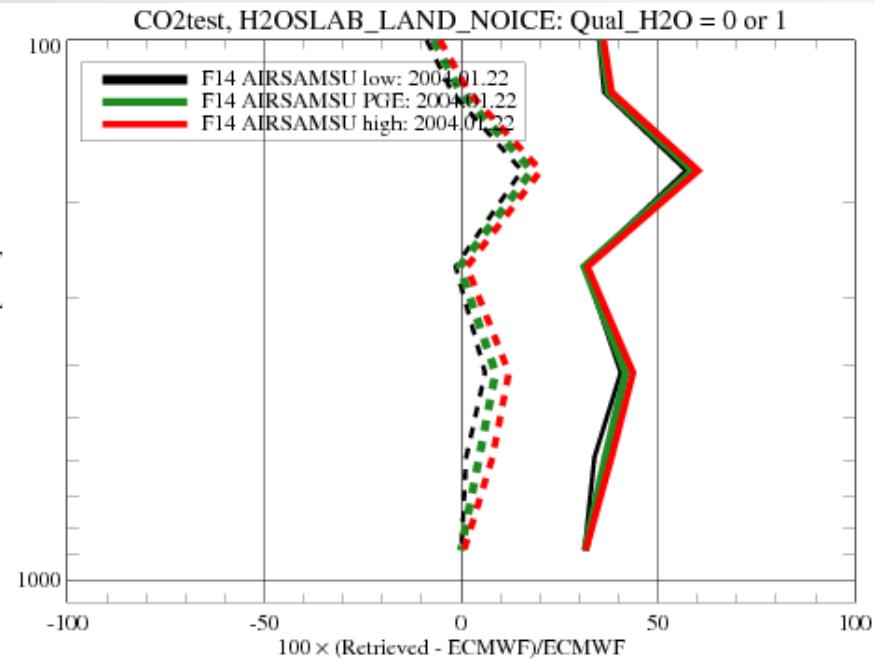
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# $\text{CO}_2$ vertical effect on water vapor

Ocean



Land



Low  $\text{CO}_2$  reduces the amount of water vapor in the troposphere.



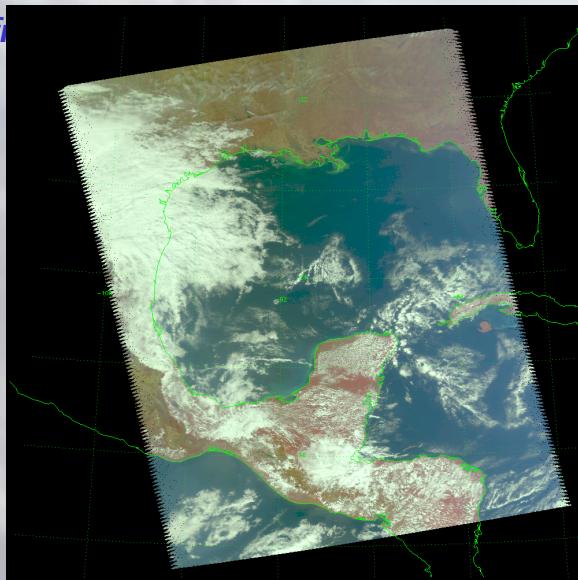
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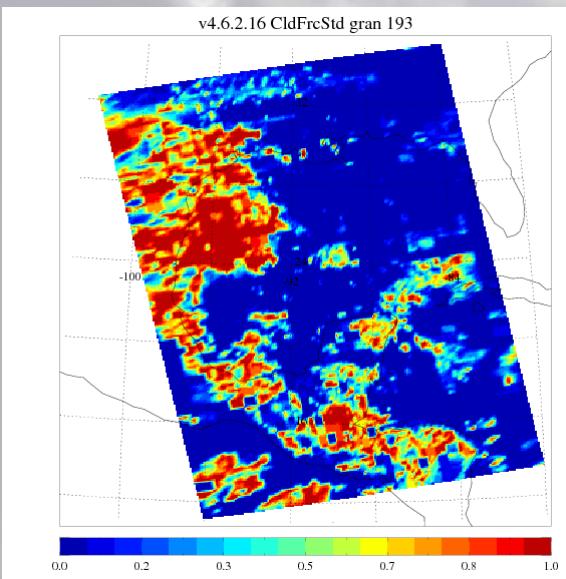
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# CO<sub>2</sub> effect on cloud fraction

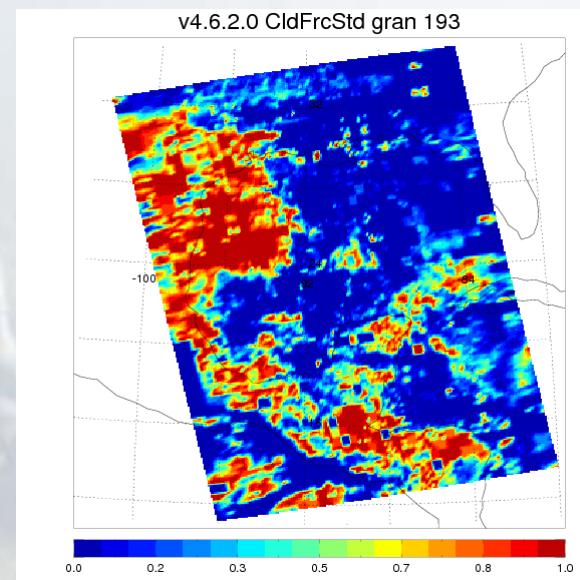
visible



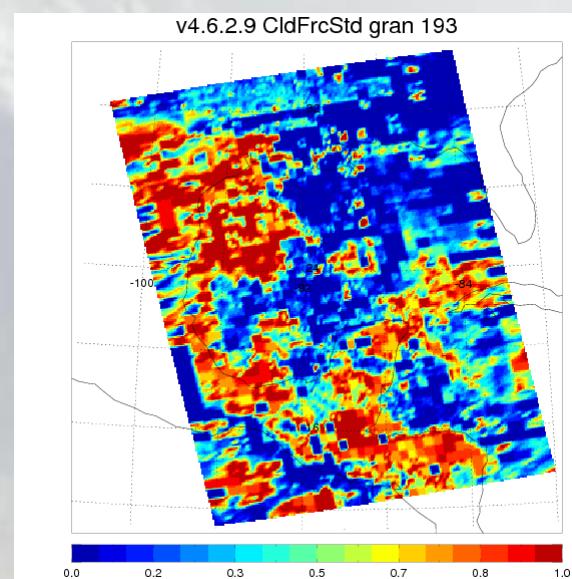
5% less  
CO<sub>2</sub>



v4.6.2



5% more  
CO<sub>2</sub>



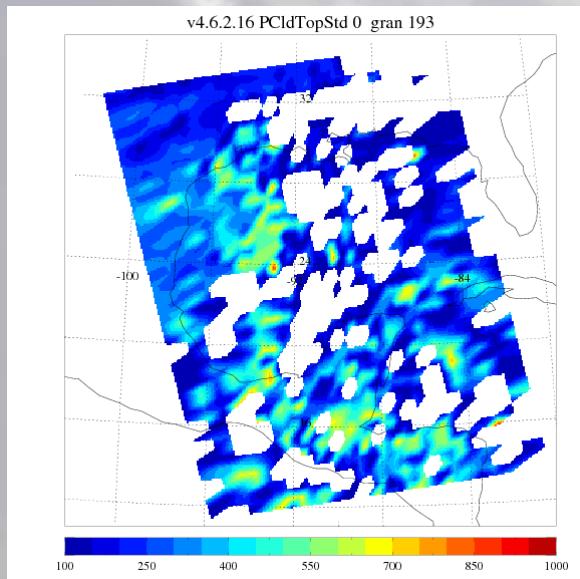
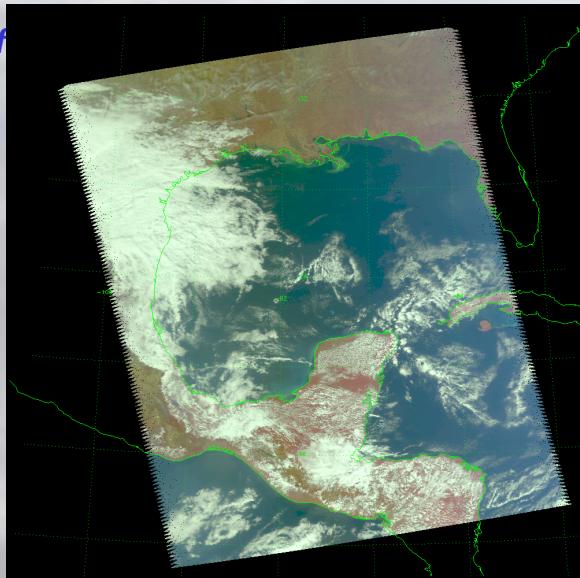


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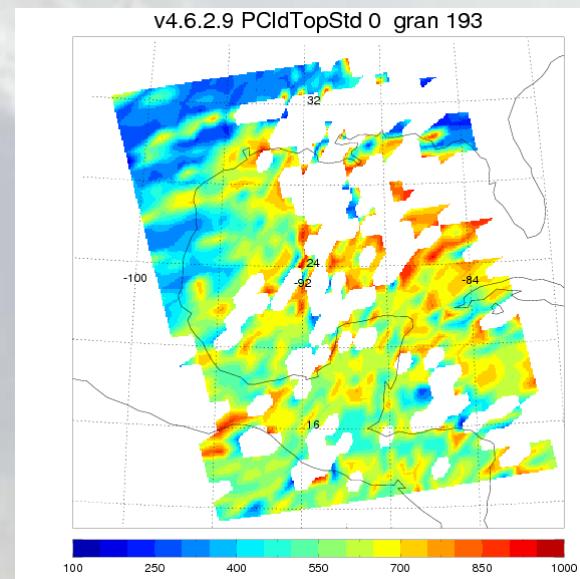
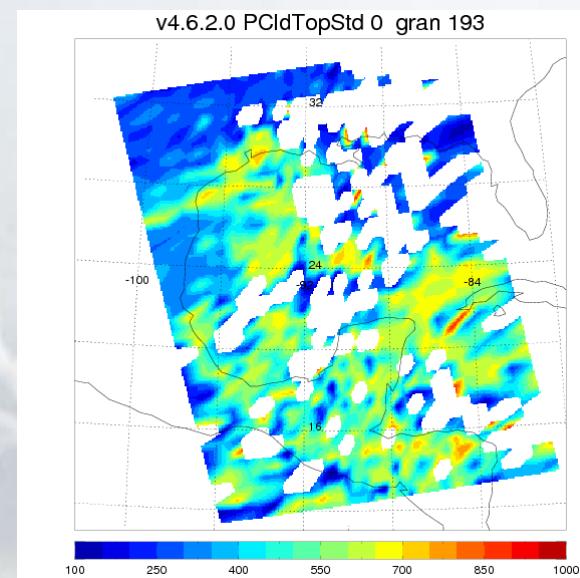
Atmospheric Inf

visible



5% Less  
CO<sub>2</sub>

v4.6.2



5% more  
CO<sub>2</sub>



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### Atmospheric Infrared Sounder

- AIRS, AMSU, and AIRS-Only retrieved temperature is increasing in the lower troposphere over ocean relative to ECMWF.
- Time varying CO<sub>2</sub> contributes to the trend but is not the only factor.
- CO<sub>2</sub> amount affects clouds.

Possible causes for the temperature bias trend:

- CO<sub>2</sub> amount
- Microwave Calibration
- Regression retrieval
- All of the above



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# Extra Slides



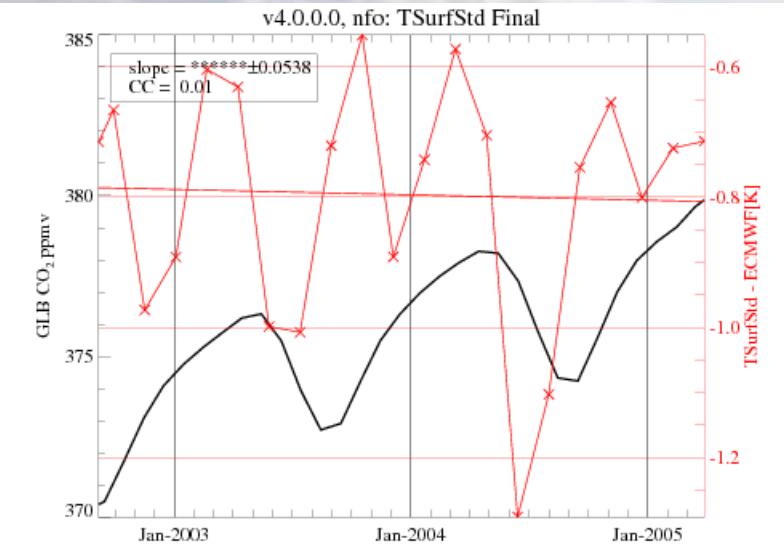
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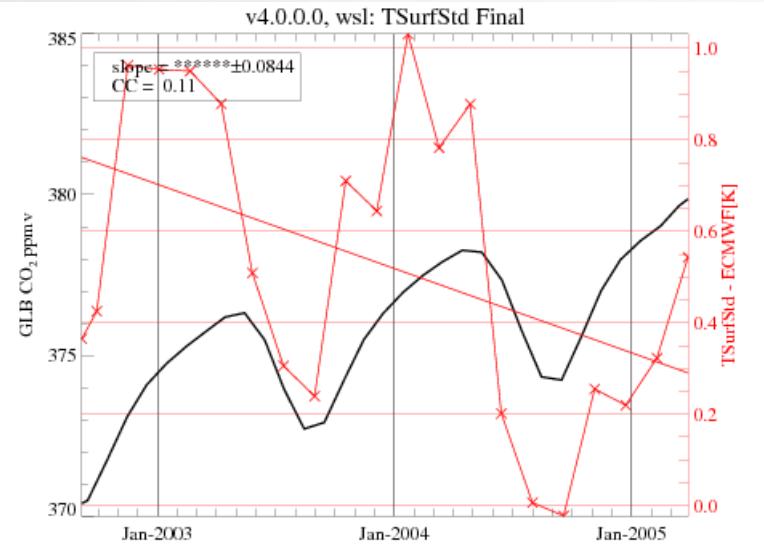
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# surface temperature trends

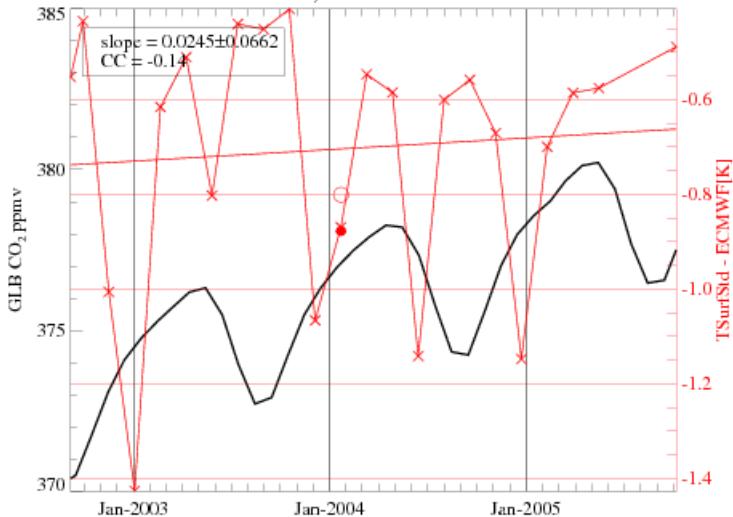
## Ocean



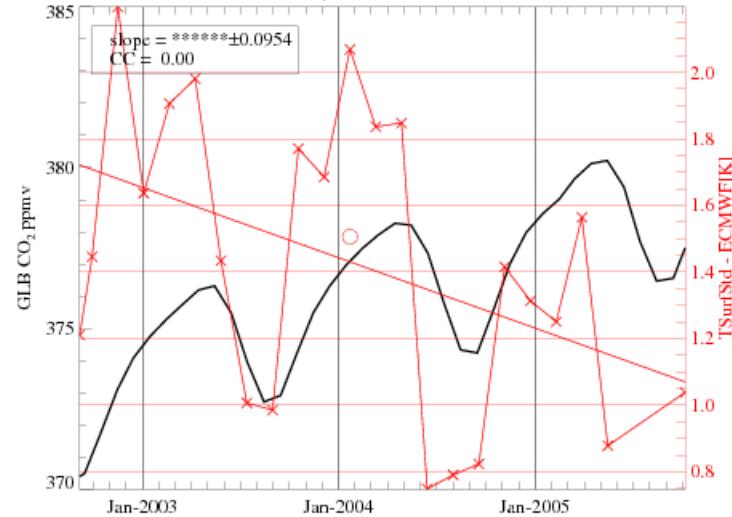
## Land



v4.6.2.0, nfo: TSurfStd Final



v4.6.2.0, wsl: TSurfStd Final



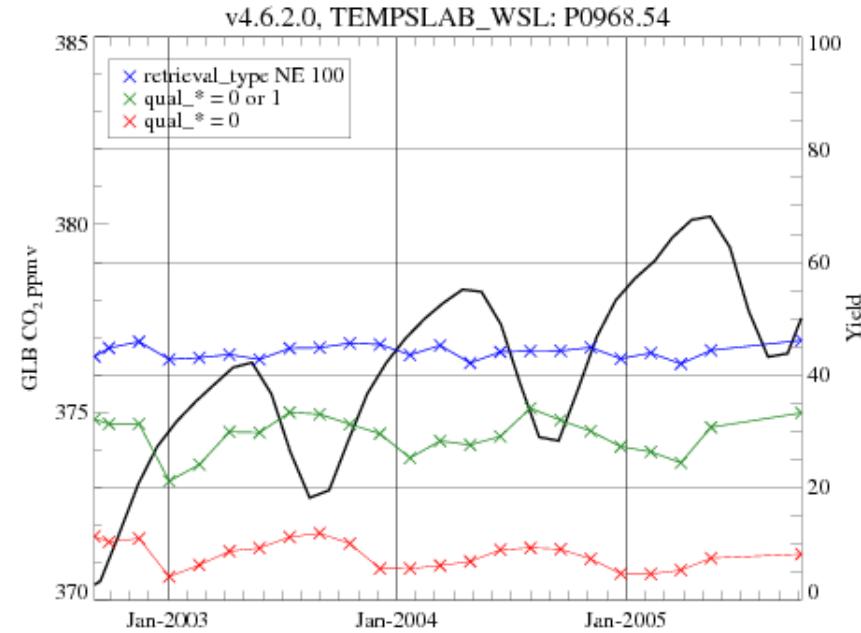
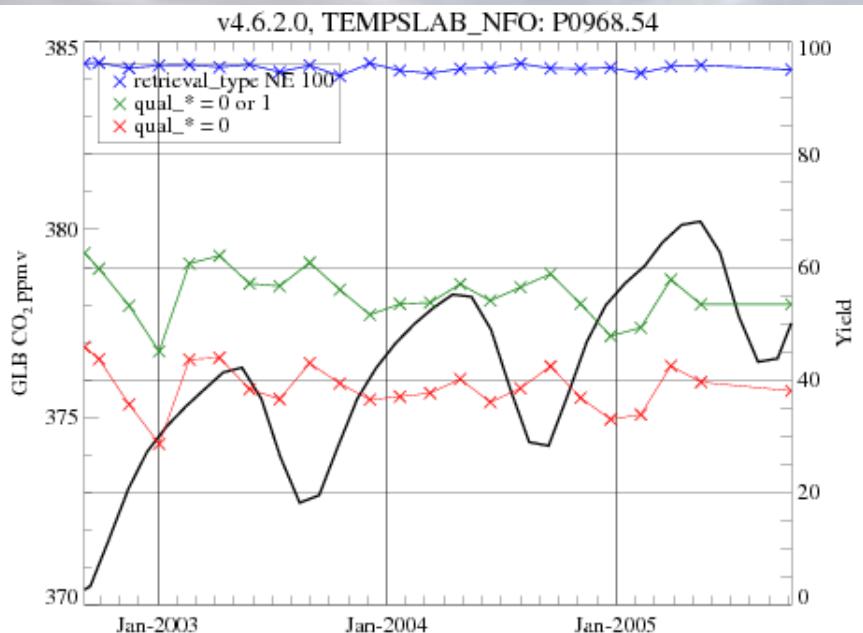


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## Atmospheric Infrared Sounder

# Yield 850-Surface



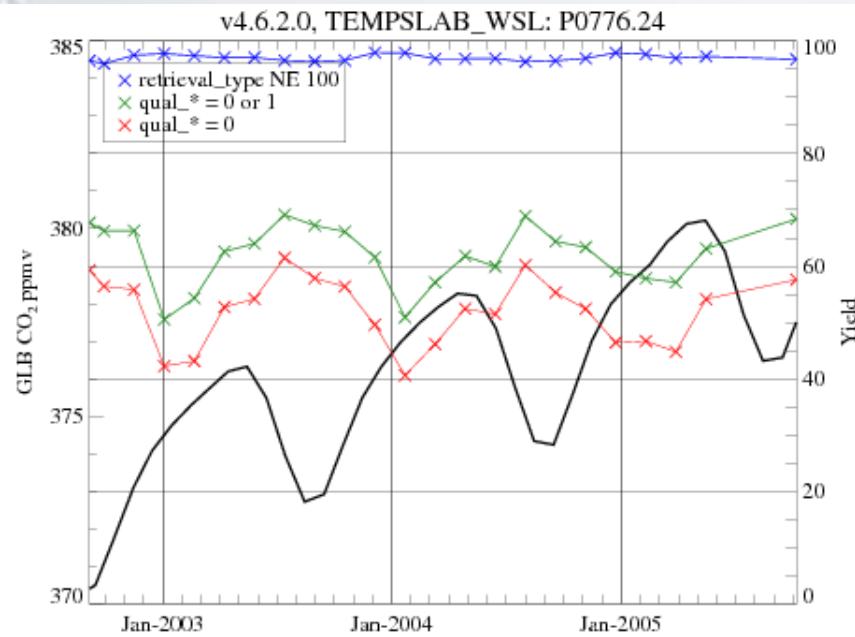
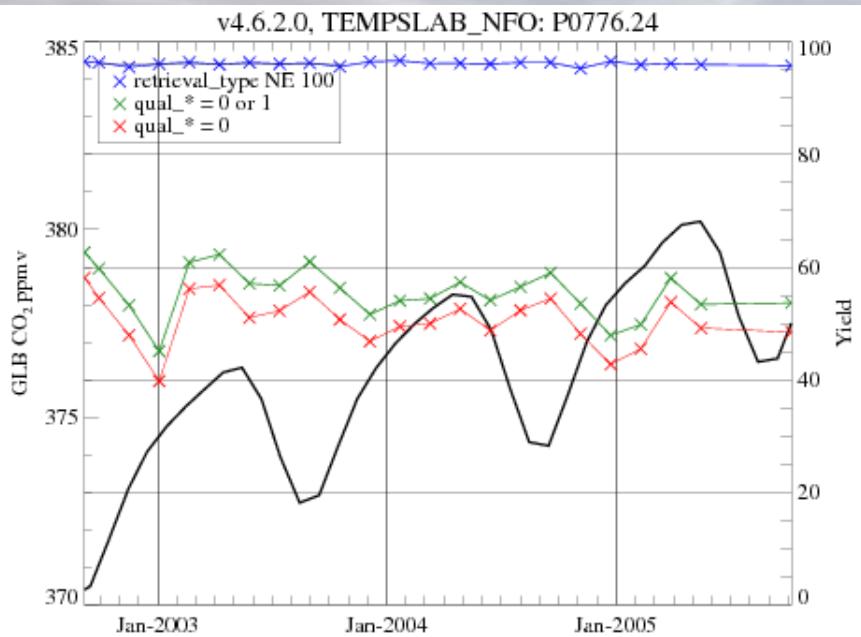


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## Atmospheric Infrared Sounder

# Yield 700-850 mbar



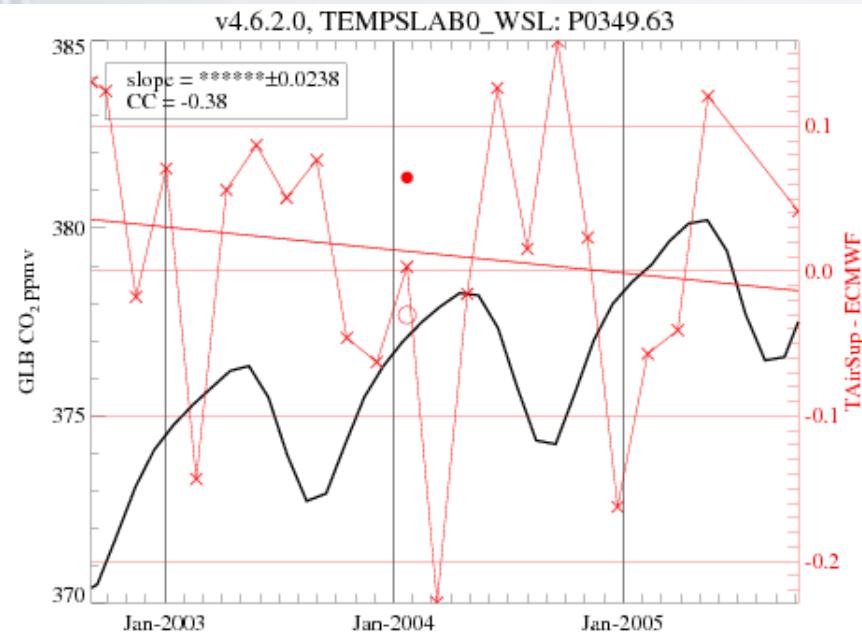
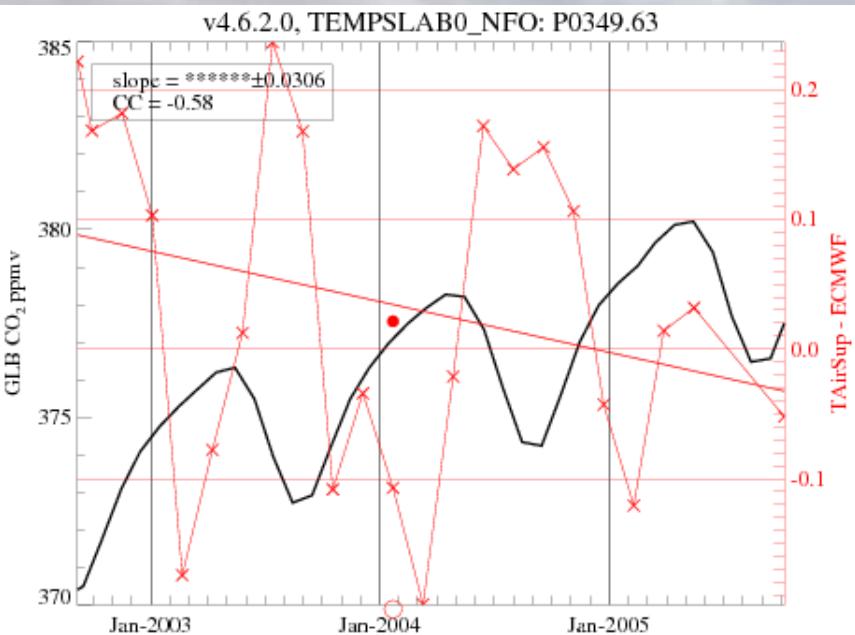


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Atmospheric Infrared Sounder

# Temperature Bias 300-400 mbar



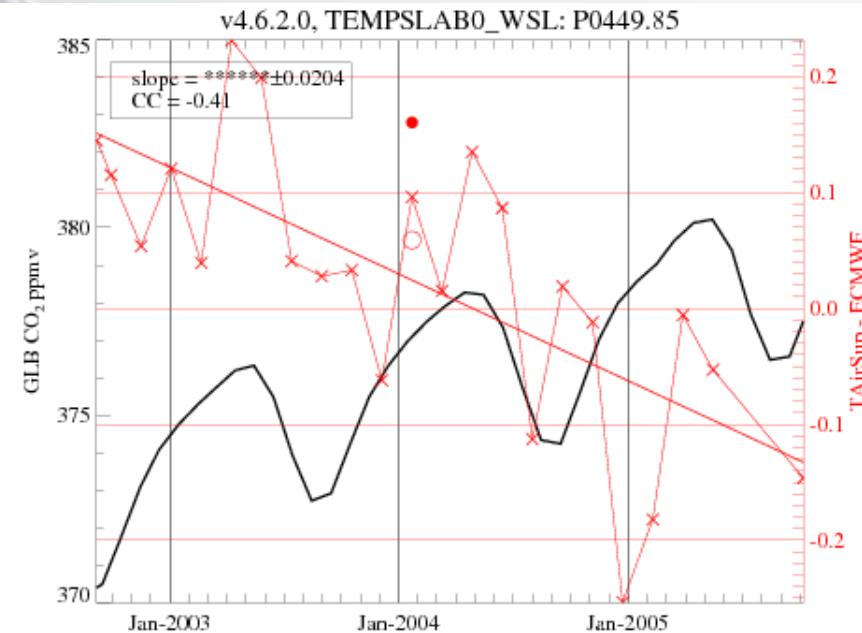
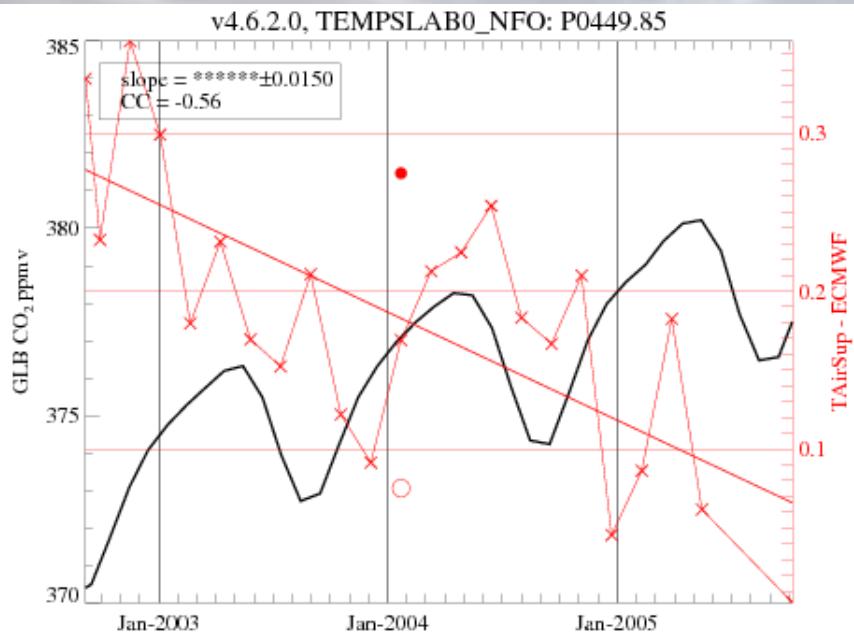


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## Atmospheric Infrared Sounder

# Temperature Bias 400-500 mbar



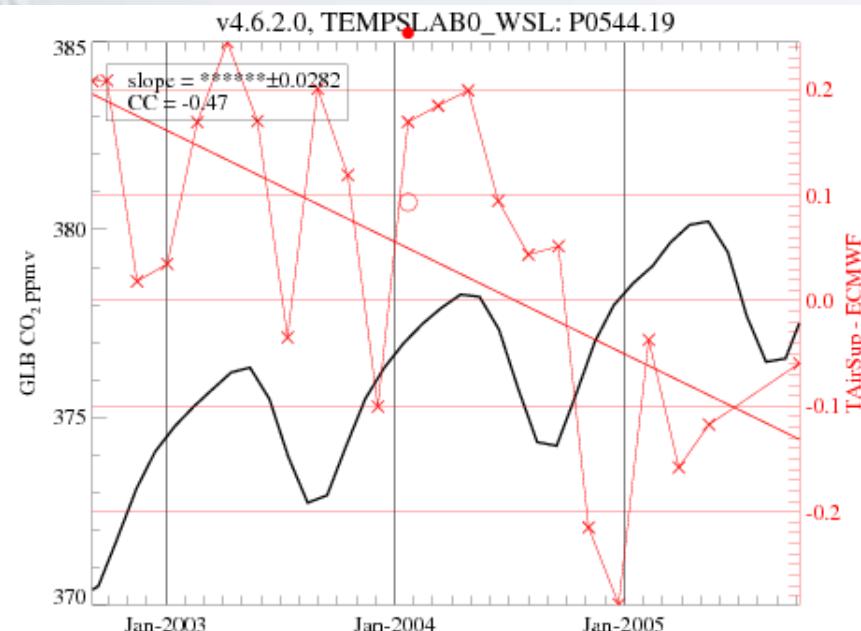
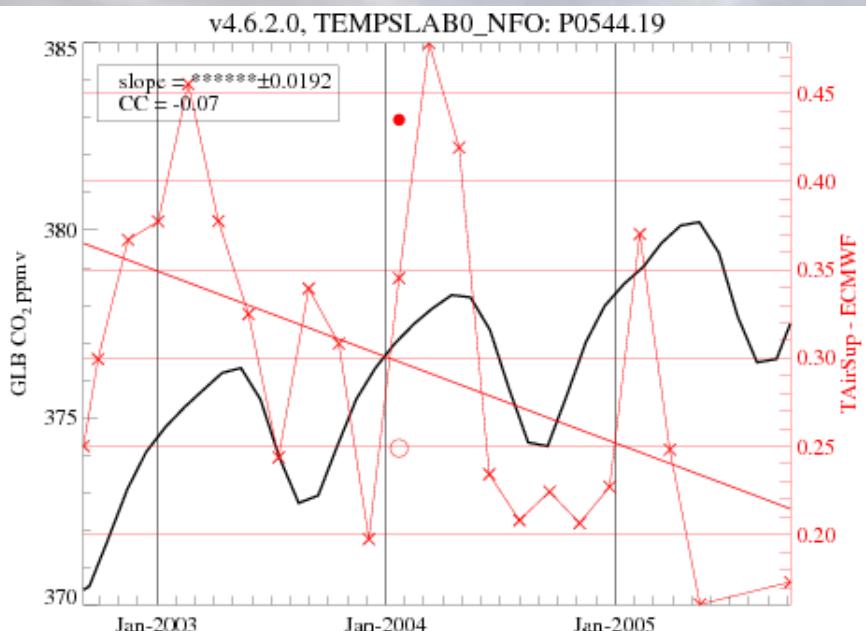


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# Temperature Bias 500-600 mbar



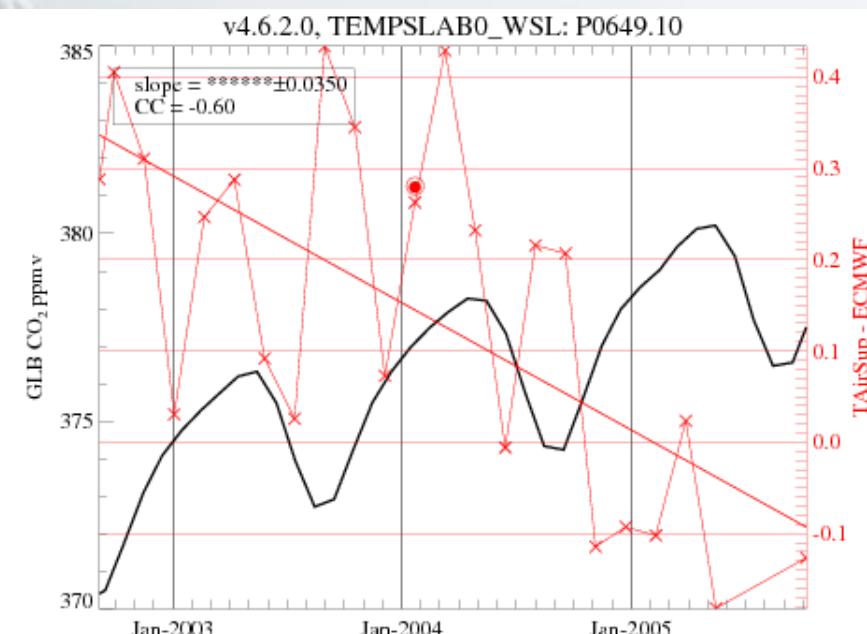
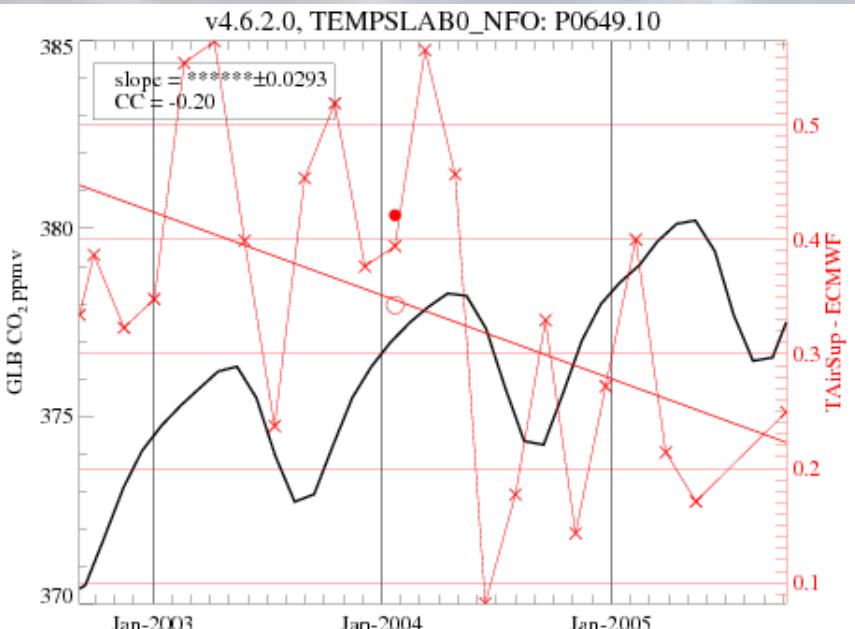


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# Temperature Bias 600-700 mbar



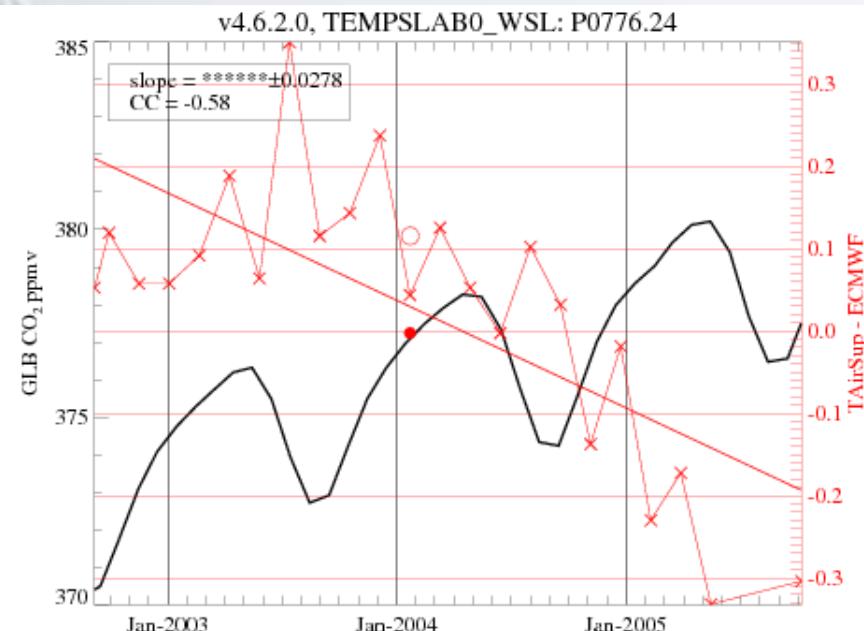
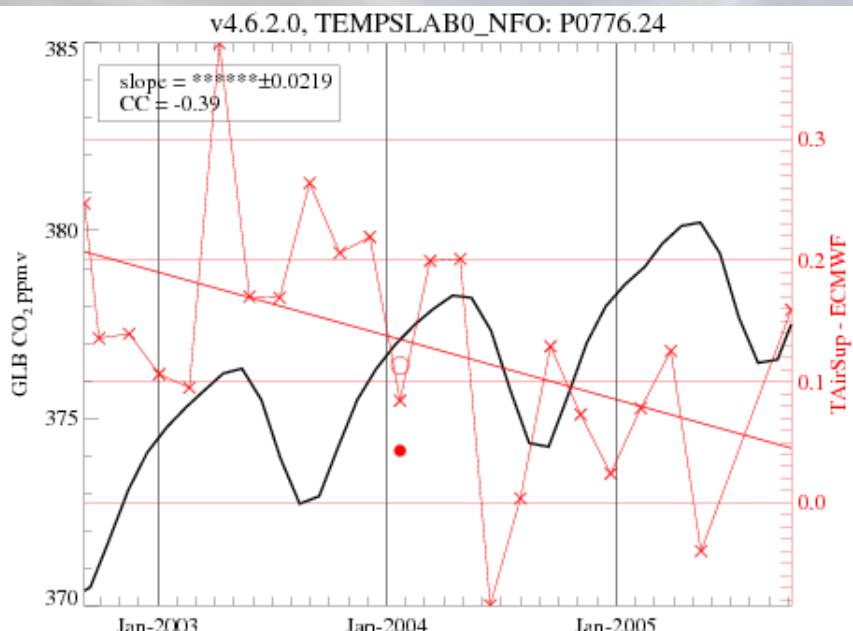


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# Temperature Bias 700-850 mbar



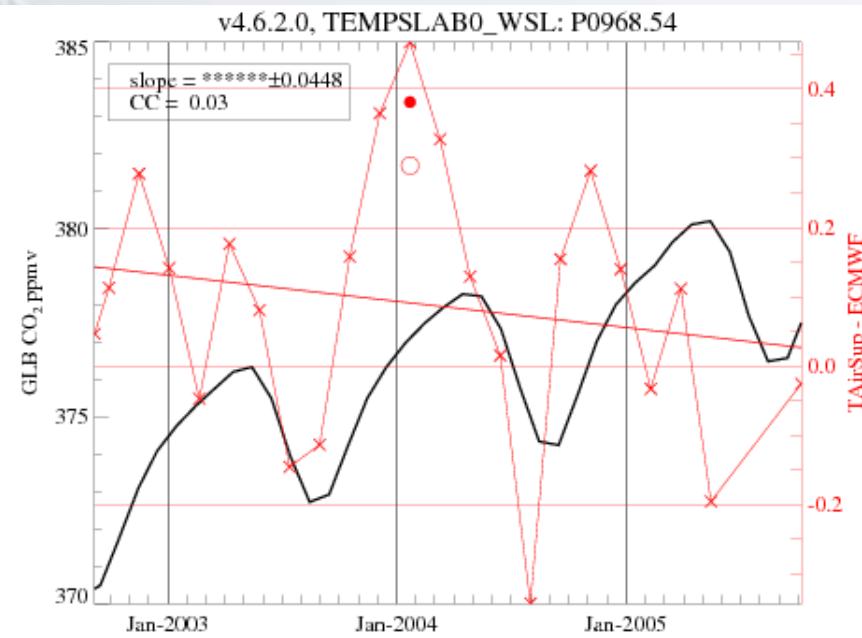
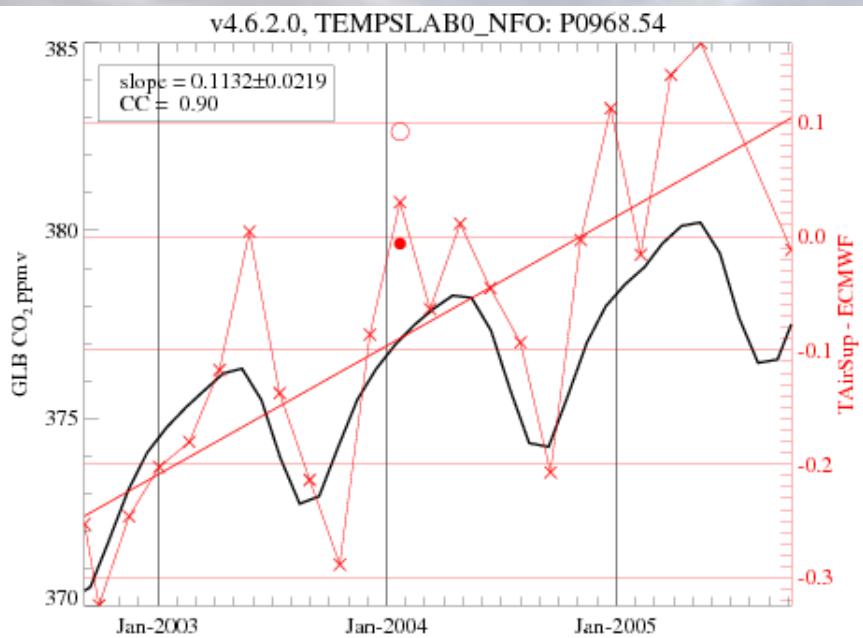


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# Temperature Bias 850 mbar to surface



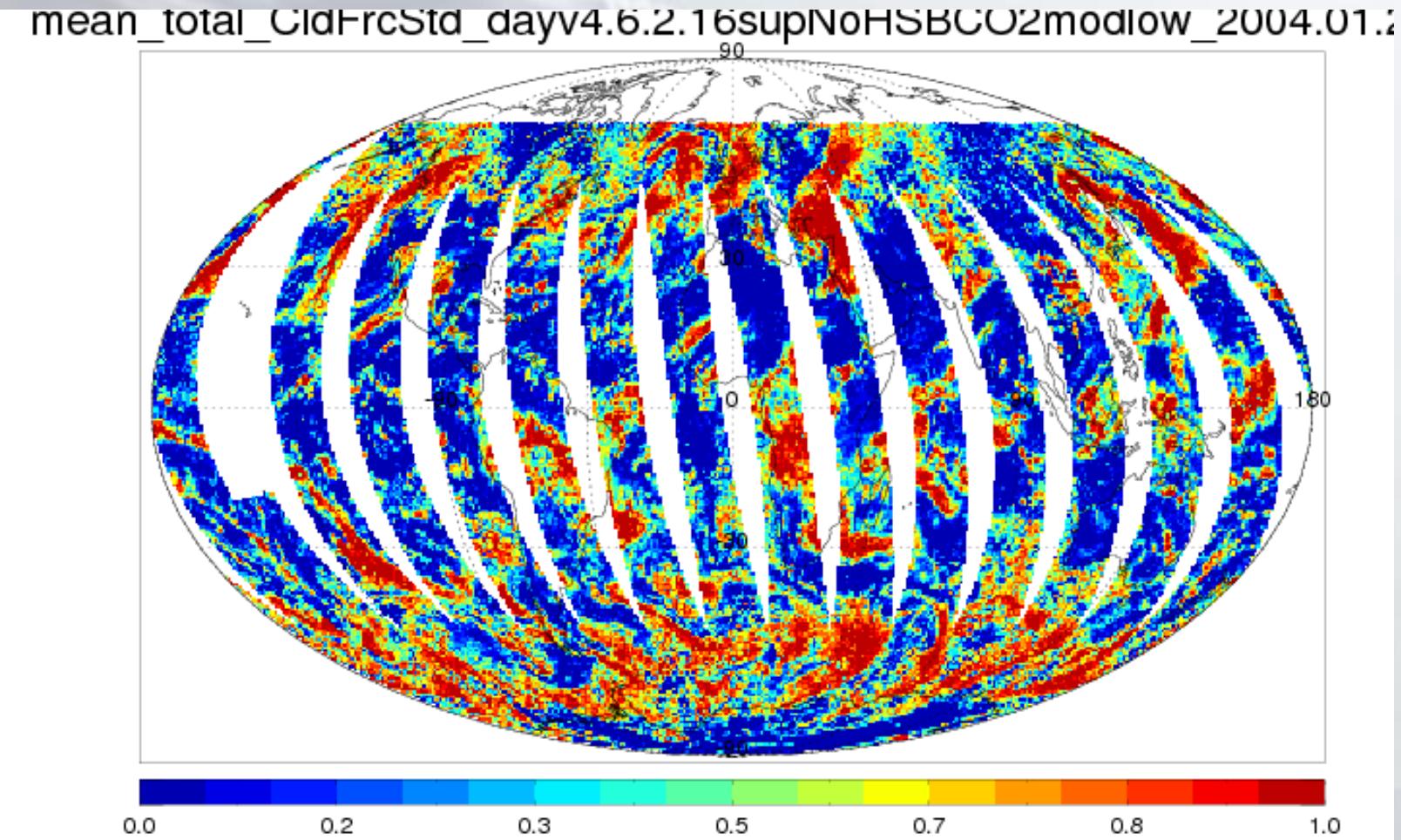


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## Atmospheric Infrared Sounder

5% low



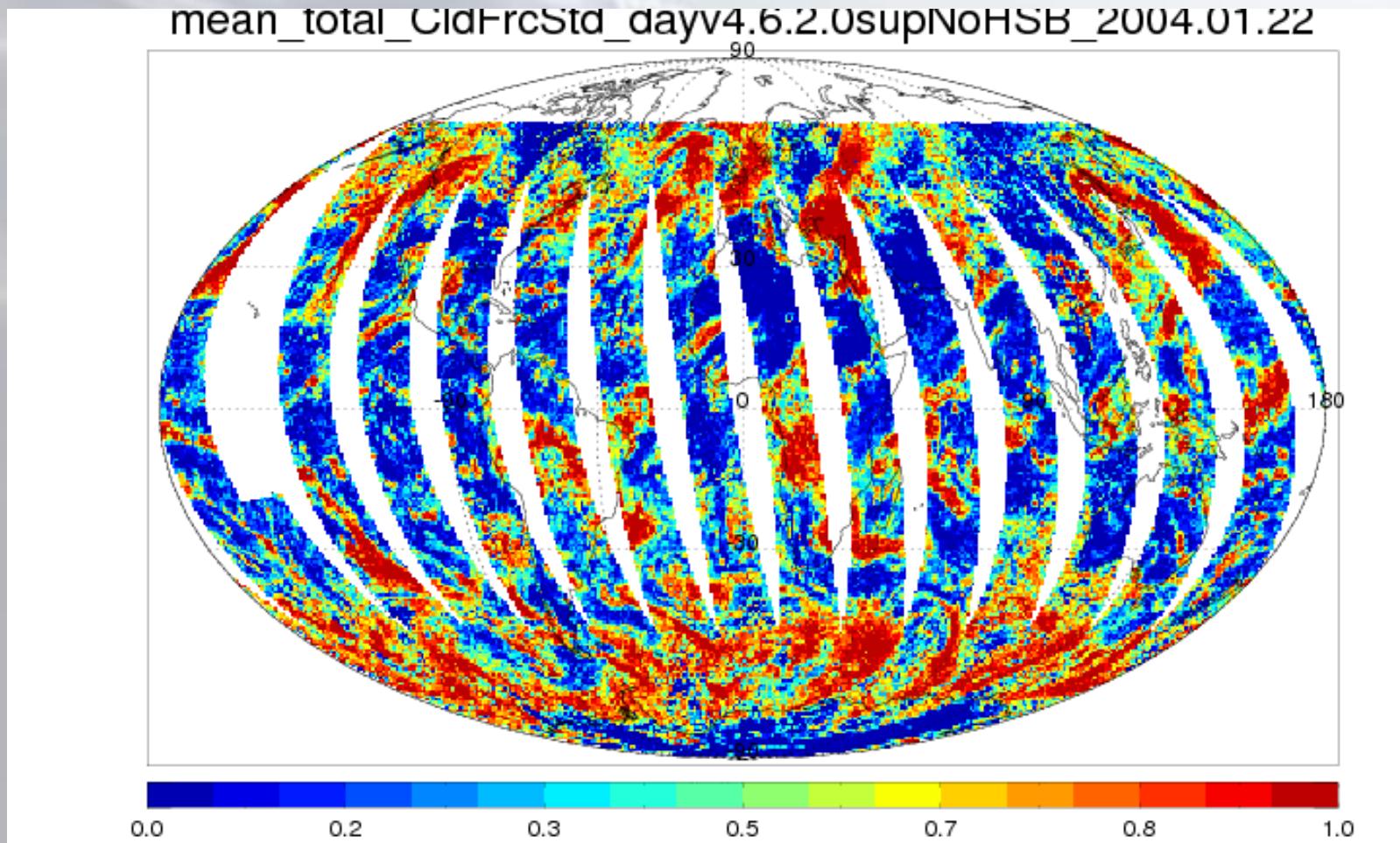


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Atmospheric Infrared Sounder

# Operational



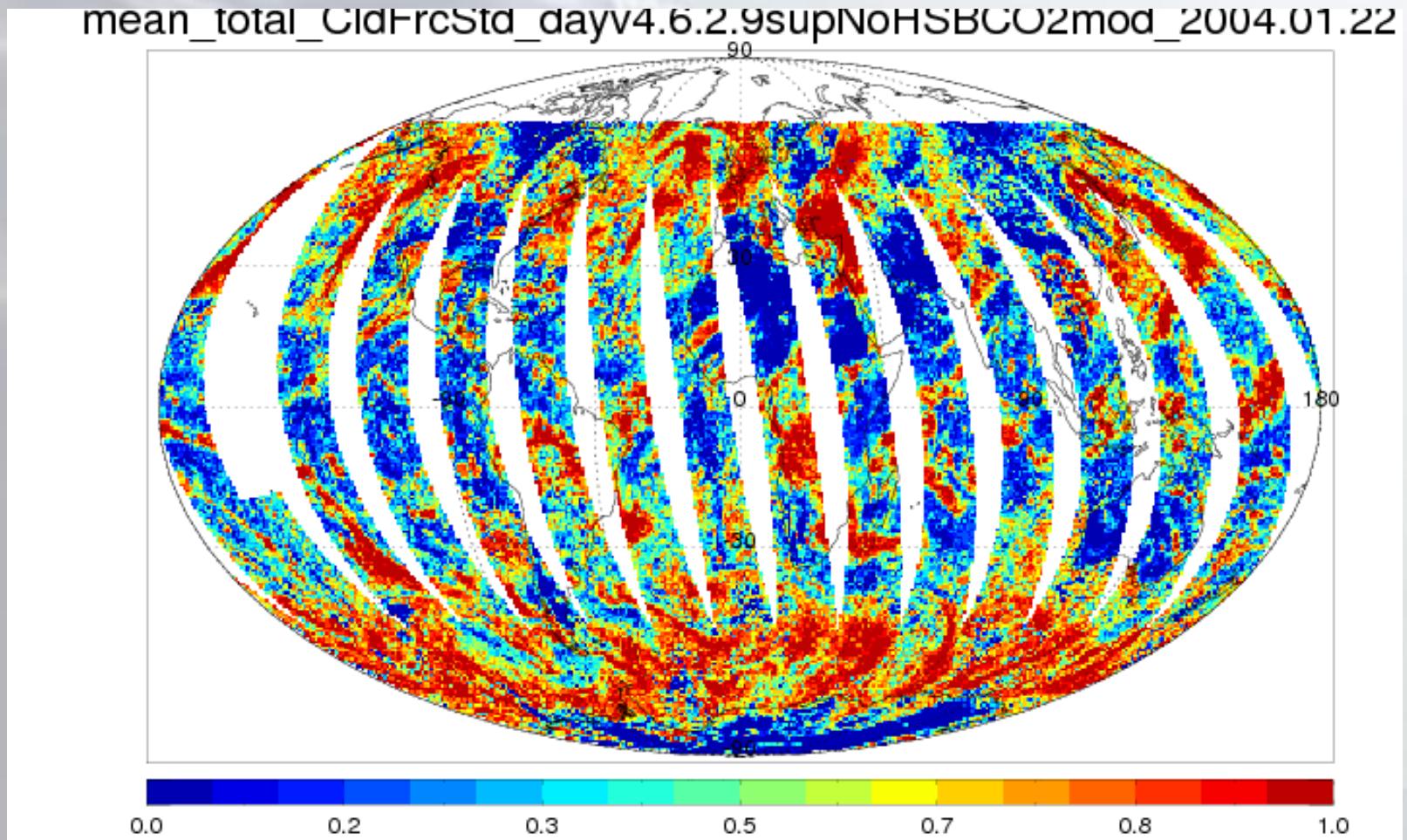


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## Atmospheric Infrared Sounder

# 5% High



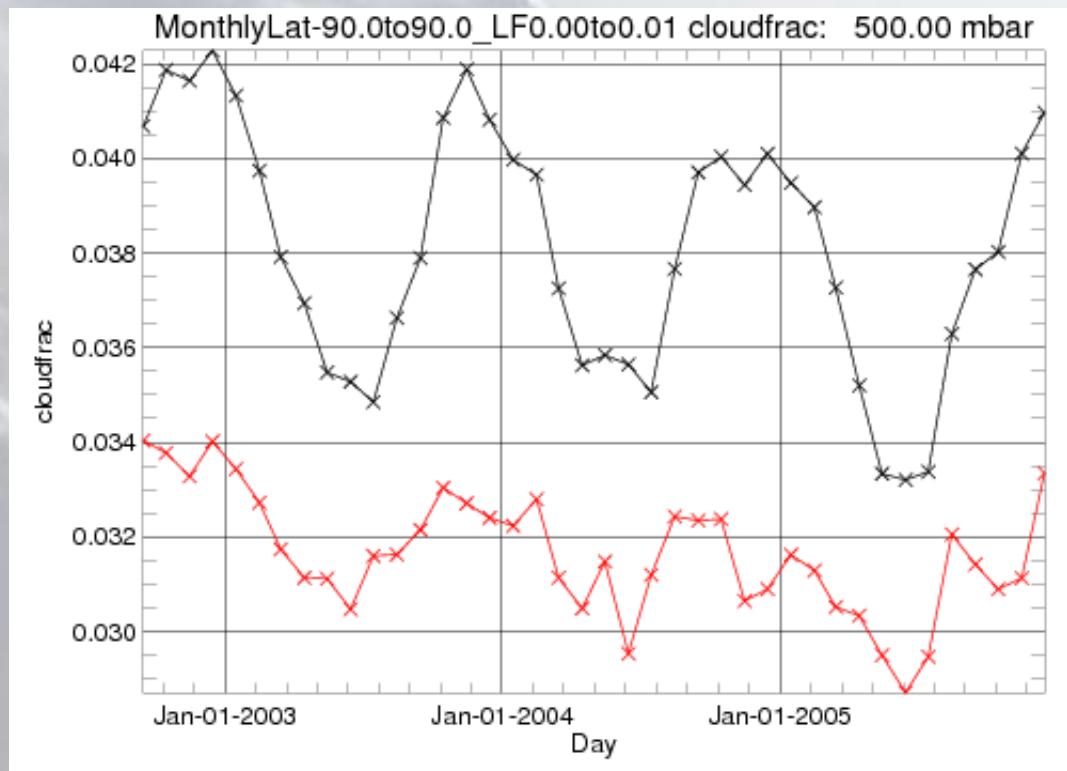


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# cloud fraction 400-500 mbar



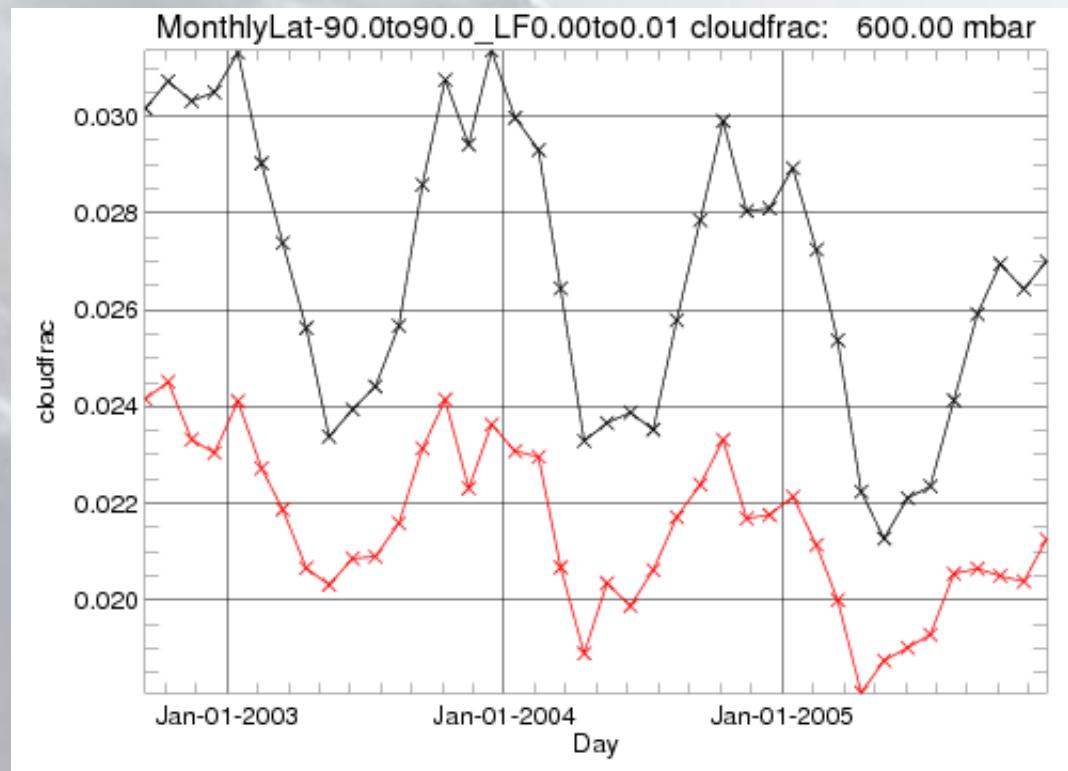


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# cloud fraction 500-600 mbar



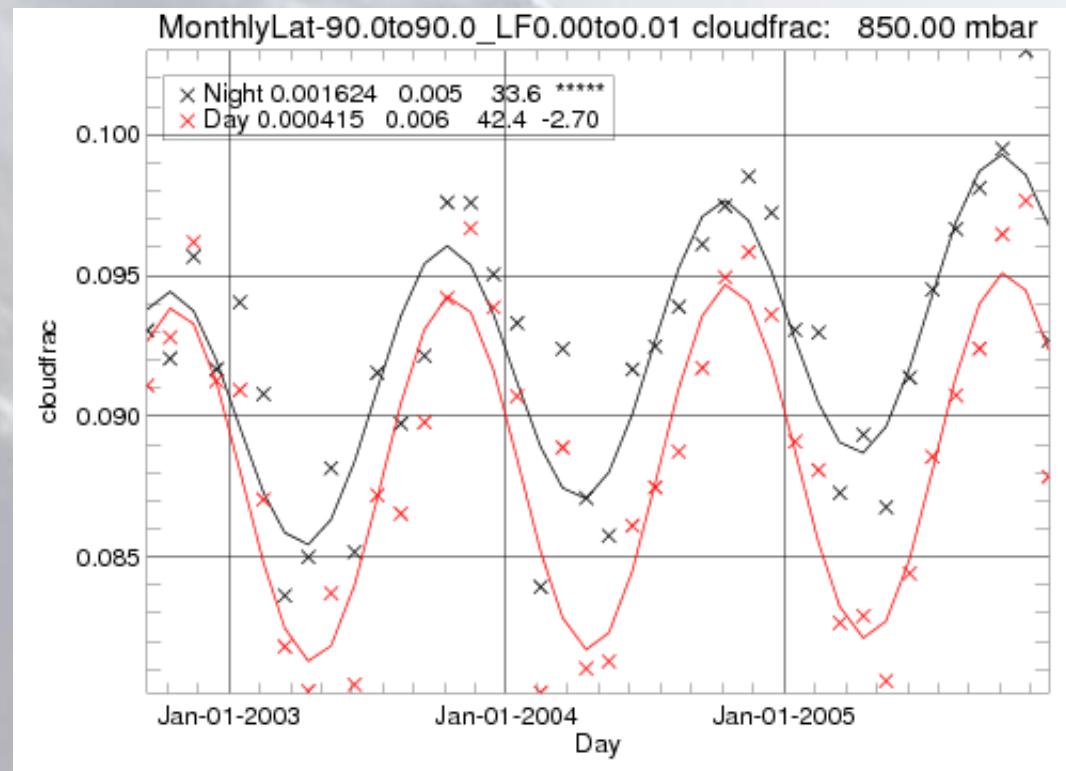


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# cloud fraction 600-850 mbar



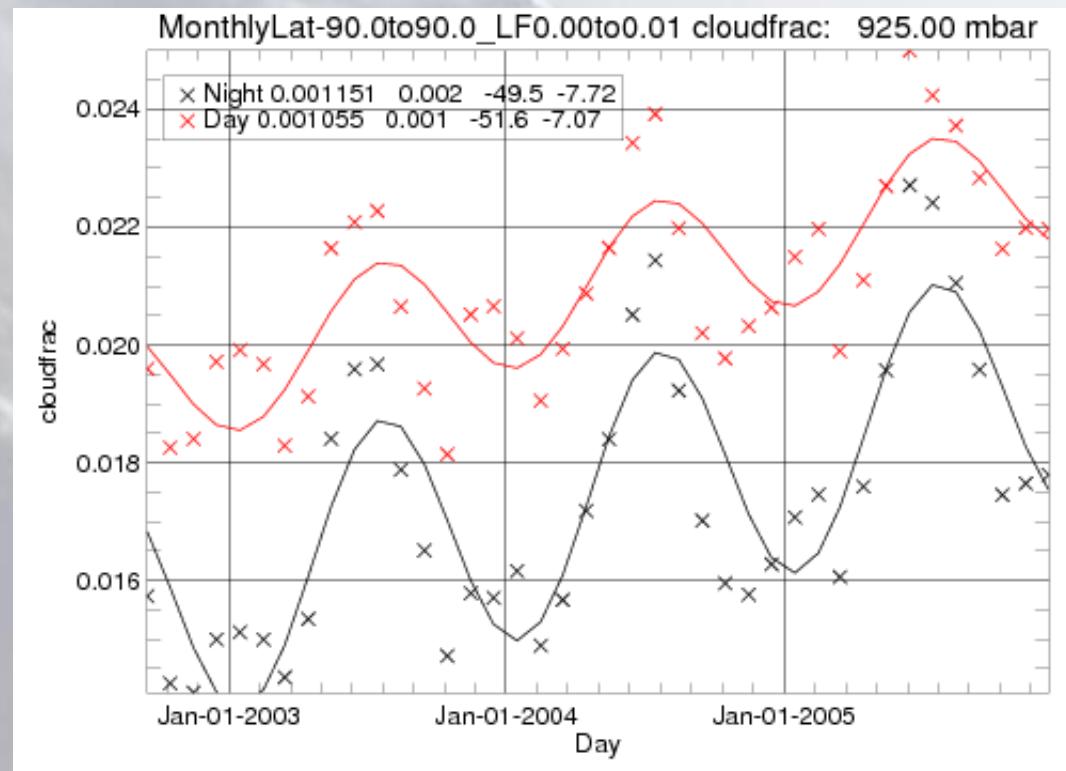


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Atmospheric Infrared Sounder

# cloud fraction 850-925





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Atmospheric Infrared Sounder

# cloud fraction 925 mbar-surface

